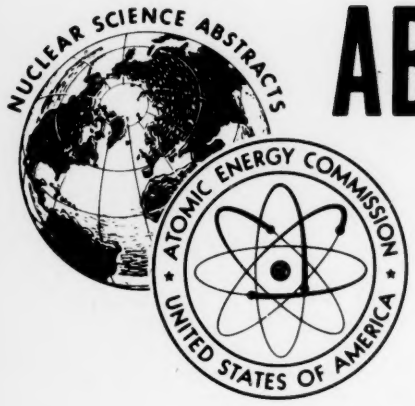
NUCLEAR SCIENCE ABSTRACTS



Volume 28 Number 5

Abstracts 10629-12605

September 15, 1973

UNITED STATES ATOMIC ENERGY COMMISSION

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Volume 28, Number 5, September 15, 1973

NUCLEAR SCIENCE ABSTRACTS

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Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

DIENSTBIER, Z., Effect of para-aminomethylbenzoic acid on the post-irradiation disturbance of haemocoagulation in dogs after whole-body exposure to 600 R, 27:20122
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DIETZEL, H., HEOS 2 and HELIOS micrometeoroid experiments, 27:20588

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Examples:

ACCELERATOR FACILITIES/DESIGN
  Design of a neutron therapy facility for a 30-inch cyclotron, 27:25413
ACETONE/RADIOLYSIS
  Pulse radiolysis of alkyl ketones, 27:24388
  Radiothermoluminescence of aliphatic ketones (Gamma radiation), 27:24389
AEROSOL GENERATORS/OPERATION
  Operating characteristics of two compressed air nebulizers used in inhalation experiments, 27:24522 (LF--45)

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21102 (ORNL-4846) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH COPPER FOR INCIDENT NEUTRON ENERGIES BETWEEN 1.0 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. **(Oak Ridge National Lab., Tenn).** Feb 1973. Contract W-7405-eng-26. 44p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
  Gamma-ray production due to neutron interactions with copper for incident neutron energies between 1.0 and 20 MeV: tabulated differential cross sections, 27:21102 (ORNL-4846)

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4846	**27-21102**	**Dep. NTIS $4.00, 44p.**
ORNL-EIS-		
73-52(Vol. 1)(No.2)	**27-21978**	**Dep. NTIS, 13p.**
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Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

TABLE OF CONTENTS

Volume 28, Number 5, September 15, 1973

Category	Page
CHEMISTRY	1007
Analytical and Separations Chemistry	1007
Activation and Nuclear Reaction Procedures	1007
Chemical and Spectral Procedures	1009
Radiometric and Radiochemical Procedures	1011
Separation Procedures	1012
Inorganic, Organic, and Physical Chemistry	1013
Chemical and Physicochemical Properties	1013
Isotope Effects	1013
Isotope Exchange and Isotope Separation	1015
Feed Materials Processing	1016
Radiation Chemistry	1016
Radiochemistry and Nuclear Chemistry	1019
Hot-Atom Chemistry	1019
Properties of Radioactive Materials	1019
Radioactive Waste Treatment	1021
Radioisotope Production	1021
Reactor Fuel Reprocessing	1022
ENGINEERING	1023
Energy Conversion	1023
Facilities and Equipment	1023
Heat Transfer and Fluid Flow	1026
Materials Testing	1026
Nuclear Explosions	1027
Protective Structures and Equipment	1030
Vacuum Engineering	1030
ENVIRONMENTAL AND EARTH SCIENCES	1031
Minerals and Ores	1031
Radioactive Effluents	1031
Radioactivity Monitoring and Transport	1032
Atmosphere	1032
Soil	1033
Water	1034
Ecosystems and Food Cycles	1034
Radiometric Techniques	1035
Site Surveys	1036
Thermal Effluents	1037
Chemical Effluents	1038
INSTRUMENTATION	1039
Radiation Detection Instruments	1039
General Detectors and Monitors	1039
Radiation Dosimeters	1039
Nuclear Spectroscopic Instrumentation	1040
High Energy Physics Instrumentation	1041
Radiometric Instruments	1042
Radiation Effects on Instrument Components, Instruments, or Electronic Systems	1044
Miscellaneous Instruments	1044
ISOTOPE AND RADIATION SOURCE TECHNOLOGY	1046
Isotope Separation (Industrial)	1046

Category	Page
ISOTOPE AND RADIATION SOURCE TECHNOLOGY (Cont'd.)	
Radiation Sources	1046
Industrial Uses	1046
LIFE SCIENCES	1050
Radiation Effects on Biochemicals	1050
Radiation Effects on Cells	1050
Radiation Effects on Microorganisms	1051
Radiation Effects on Plants	1051
Radiation Effects on Animals	1054
Man	1054
Vertebrates	1056
Invertebrates	1059
Radionuclide Effects (Internal Source)	1059
Man	1059
Animals	1060
Nuclide Kinetics and Toxicology	1061
Man	1061
Animals	1061
Plants	1063
New Tracer Techniques	1063
MATERIALS	1065
Ceramics and Cermets	1065
Metals and Alloys	1072
Corrosion and Erosion	1072
Preparation and Fabrication	1073
Properties, Structure, and Phase Studies	1074
Radiation Effects	1083
Other Materials	1085
NUCLEAR MATERIALS AND WASTE MANAGEMENT	1089
Accountability and Safeguards	1089
Disposal and Storage	1089
Handling Equipment and Procedures	1089
Transportation	1089
PARTICLE ACCELERATORS	1091
Design, Development, and Operation	1091
Auxiliaries and Components	1091
Ion Sources and Injection and Extraction Systems	1091
Ion Optics and Field Calculations	1092
Experimental Facilities	1092
PHYSICS (ASTROPHYSICS AND COSMOLOGY)	1093
Cosmic Radiation	1093
Stars	1095
Quasi-Stellar, Radio, and X-Ray Sources	1097
Solar Phenomena	1097
Galaxies	1100
Cosmology	1101
Planetary Phenomena	1102

TABLE OF CONTENTS (continued)

Category	Page
PHYSICS (ATMOSPHERIC)	1115
Auroral and Ionospheric Phenomena	1115
Effects of Nuclear Detonations	1116
Magnetospheric Phenomena	1117
PHYSICS (ATOMIC AND MOLECULAR)	1120
Beams and Their Reactions	1120
Atomic and Molecular Properties	1120
Positronium, Muonium, and Muonic and Mesic Atoms and Molecules	1120
Collision Phenomena	1120
Atomic Theory	1121
PHYSICS (ELECTROFLUID AND MAGNETOFLUID)	1122
PHYSICS (HIGH-ENERGY)	1123
Particle Interactions and Properties (Experimental)	1123
Electromagnetic	1123
Weak	1123
Strong (Baryon-induced)	1124
Strong (Meson-induced)	1125
Particle Interactions and Properties (Theoretical)	1127
General	1127
Electromagnetic	1127
Weak	1128
Strong (General)	1129
Strong (Baryon No. = 0)	1130
Strong (Baryon No. = 1)	1131
Strong (Baryon No. ≥ 2)	1132
Particle Invariance Principles and Symmetries	1133
General	1133
Applications (Electromagnetic and Weak)	1134
Applications (Strong)	1134
Scattering Theory	1134
PHYSICS (LOW-TEMPERATURE)	1136
Superfluidity	1136
Superconductivity	1136
Equipment and Devices	1136
PHYSICS (NUCLEAR)	1137
Neutron Interactions with Matter	1137
Nuclear Properties and Reactions, A < 5	1138
Nuclear Properties and Reactions, 6 < A < 19	1138
Nuclear Properties and Reactions, 20 < A < 38	1140
Nuclear Properties and Reactions, 39 < A < 58	1141
Nuclear Properties and Reactions, 59 < A < 89	1141
Nuclear Properties and Reactions, 90 < A < 149	1142
Nuclear Properties and Reactions, 150 < A < 189	1143
Nuclear Properties and Reactions, 190 < A < 219	1144
PHYSICS (NUCLEAR) (Cont'd.)	
Nuclear Properties and Reactions, A ≥ 220	1145
Nuclear Theory	1146
PHYSICS (PLASMA AND THERMONUCLEAR)	1150
Confinement and Heating	1150
Diagnostics	1150
Kinetics (General)	1150
Kinetics (Experimental)	1151
Kinetics (Theoretical)	1152
Production	1153
Stability	1153
Thermonuclear Engineering and Equipment	1154
Wave Phenomena	1154
PHYSICS (RADIATION AND SHIELDING)	1156
Radiation Physics	1156
Shielding Calculations and Experiments	1156
PHYSICS (THEORETICAL)	1157
General	1157
Quantum Field Theories	1157
Gravitation and General Relativity	1158
REACTOR TECHNOLOGY AND REGULATION	1159
Power Reactors, Non-Breeding, BWR-Type	1159
Power Reactors, Non-Breeding, PWR-Type	1159
Power Reactors, Non-Breeding, Graphite Moderated	1160
Power Reactors, Non-Breeding, Otherwise Moderated	1161
Power Reactors, Breeding	1161
Research, Test, and Experimental Reactors	1162
Production and Materials Testing and Processing Reactors	1167
Propulsion and Package Reactors	1167
Reactor Safety and Environmental Aspects	1168
Reactor Theory and Calculation	1171
Reactor Components and Accessories	1172
Reactor Fuels	1174
Reactor Control Systems	1174
Reactor Licensing and Regulation	1174
GENERAL	1186
Energy Utilization and Economics	1186
Management	1187
Mathematics and Computers	1187
Miscellaneous	1187
CORPORATE INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-15
SUBJECT INDEX	INDEX-60
REPORT NUMBER INDEX	INDEX-145

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 10844, 10926, 10940, 10951, and 10967.

10629 (UCID-15644-72-1) ANALYTICAL CHEMISTRY QUARTERLY REPORT, JANUARY-MARCH 1972. Harrar, J. E. (ed.). (California Univ., Livermore. Lawrence Livermore Lab.). 8 May 1972. Contract W-7405-eng-48. 72p. Dep. NTIS $5.75.

Summaries of research in progress at Lawrence Livermore Laboratory are presented. The areas covered include neutron detectors, energy-dispersive x-ray fluorescence, chromatographic analysis of high-purity helium, californium emission spectrum, ESR studies of beryllium hydride, and stability of Bk(IV) in acid solution. (DHM)

10630 (UCID-15644-72-2) ANALYTICAL CHEMISTRY QUARTERLY REPORT, APRIL-JUNE 1972. Harrar, J. E. (ed.). (California Univ., Livermore. Lawrence Livermore Lab.). 21 Aug 1972. Contract W-7405-eng-48. 60p. Dep. NTIS $5.00.

Summaries on research at Lawrence Livermore Laboratory are presented including work on atomic spectroscopy of the actinides. (DHM)

10631 (UCID-15644-72-4) ANALYTICAL CHEMISTRY QUARTERLY REPORT, OCTOBER-DECEMBER 1972. Harrar, J. E. (ed.). (California Univ., Livermore. Lawrence Livermore Lab.). 28 Feb 1973. Contract W-7405-eng-48. 44p. Dep. NTIS $4.25.

Summaries of research in progress at Lawrence Livermore Laboratory are presented. The areas covered include surface chemistry of thorium, uranium, and plutonium; oxidation of thorium in humid air and humid nitrogen; analysis of deuterated polyethylene; and system for determining tritium in solid materials. (DHM)

10632 ANALYTICAL APPLICATION OF EDTA AND RELATED COMPOUNDS. Pribil, R. International Series on Monographs in Analytical Chemistry. Volume 52. Elmsford, NY; Pergamon Press, Inc. (1972). 387p. $37.50.

The six chapter titles are: the development of EDTA as an analytical reagent; the nature of equilibria of complexes and methods of study; gravimetric analysis, including sections on the use of ammonia as precipitant in the determinations of U as U_3O_8 and Th as ThO_2, the separation of Ti, Be, and U, and the determination of Nb, use of cupferron in the determination of U in pitchblende and ore concentrates, the separation of Nb from Ta and other elements, and the determination of Nb in steel, and the use of oxine in the determinations of Mo, Th, and U in the presence of various elements; titrimetric analysis, including sections on the iodometric determination of Ce, the determination of U as $UO_2NH_4AsO_4$ and $UO_2NH_4PO_4$, the radiometric determinations of Be and Th, and the emanation determination of Ra; colorimetry, including sections on the use of EDTA and other compounds as colorimetric reagents in the determination of Fe in Zr metal, and the determination of rare earths, the use of metallochromic indicators as colorimetric reagents in determinations of Al and Cu in U, and the determinations of Zr, Th, and Nb, Sc, Y, rare earths, U, Pu, Ce, Yb, and La in various elements and alloys; EDTA as a masking agent in colorimetry, including sections on the use of various reagents in the determination of Hg in uranium compounds and metallic Se, the determination of Zr in Nb and other metals, and the determinations of Th, Nb, U, Mo, and Te in various elements, compounds, and alloys. Extensive references and a subject index are included. (JGB)

10633 ANALITICHESKAYA KHIMIYA TRANSPLUTONIEVYKH ELEMENTOV. (Analytical Chemistry of the Transplutonium Elements). Myasoedov, B. F.; Gubeva, L. I.; Milyukova, M. S.; Chmutova, M. K. Analiticheskaya Khimiya Elementov. Moscow; Izdatel'stvo Nauka (1972). 376p.

The chemical characteristics of the transplutonium elements and their compounds are reviewed. Radiometric and spectrophotometric methods of quantitative determination are described in detail for americium, curium, berkelium, californium, einsteinium, fermium, mendelevium, elements 102 and 103, and kurchatovium. A brief reference is made to mass spectroscopic and electrochemical methods. An evaluation of separative techniques is made: precipitation by inorganic and organic reagents, coprecipitation, chromatographic and electrochemical methods, including extraction by organophosphorous compounds, alkylphosphoric acids, amines, and by the formation of inner-complex compounds. 1010 references. (KSW)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 10888, 11524, 11527, 11534, 11542, and 12076.

10634 (BARC-647) DETERMINATION OF PROTEIN CONTENT IN FOOD SAMPLES BY FAST NEUTRON ACTIVATION. Misra, S. C.; Gupta, U. C.; Rao, U. S.; Bhatia, C. R. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

The feasibility of neutron activation analysis was examined, using 14 MeV neutrons, for the estimation of protein content in some food samples, mainly of plant origin. The contribution of other elements activated during irradiation was investigated by following the radioactive decay and also by recording the spectrum of irradiated samples in a multichannel analyser. Factors such as reproducibility of volume and variation of flux during irradiation are discussed and their contribution is estimated to be 1% and 0.04% respectively. The nitrogen values obtained by the activation method were in agreement within 4% with those obtained by the Kjeldahl method. (auth)

10635 (BARC-654) SURFACE ANALYSIS AND DEPTH DISTRIBUTION OF IMPURITIES USING CHARGED PARTICLES: FLUORINE IN ZIRCALOY. Gangadharan, S.; Yegnasubramanian, S. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 27p. Dep. NTIS (U. S. Sales Only) $3.50.

Analytical applications of charged particle-induced nuclear reactions are briefly described; in particular, the use of charged particle beams as microprobes for studying the surface and depth distribution of impurities is discussed. The determination of fluorine in zircaloy using the proton-induced reaction $^{19}F(p,\alpha\gamma)^{16}O$ is dealt with in detail. The surface and depth distribution of fluorine in zircaloy coupons pickled for different durations and some zircaloy claddings of fuel elements was investigated. The results for the coupons are in agreement with the earlier reported values and the observations with the tubes are discussed in the light of the problem referred, regarding their surface characteristics after the process of pickling, washing and autoclaving. (auth)

10636 (CONF-721010-47) NEUTRON ACTIVATION ANALYSIS OF COPPER, MERCURY, AND ANTIMONY BY SUBSTOICHIOMETRIC EXTRACTION TECHNIQUE. Haldar, B. C.; Tejam, B. M. 1972. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A simple and accurate method was developed for the determination of copper, mercury, and antimony by thermal neutron activation analysis involving substoichiometric extraction technique. The results of analysis indicate that copper, mercury, and antimony in biological samples can be determined with an accuracy of 5.3%, 5.6%, and 6.5% respectively. Two samples and a standard can be analyzed by the proposed method in about 4 hours. (Fr)

10637 (RLO-2227-T-7-22) NUCLEAR CHEMISTRY PROGRESS REPORT, MARCH 15, 1972 TO MARCH 15, 1973. Loveland, W. D. (Oregon State Univ., Corvallis). Mar 1973. Contract AT(45-1)-2227. 100p. Dep. NTIS $6.75.

Separate entries were prepared for five of the studies on nuclear physics. In the remaining investigations neutron activation analysis is used in studies of atmospheric trace element abundances associated with agricultural field burning, the "continental" contribution to atmospheric trace element abundances, trace element content of cigars, cigar ash and smoke, trace element abundances in air particulate collection media, and the use of stable activable tracers as indicators of pollutant flow patterns. (DHM)

For abstracts of individual sections see: 10961, 11865, and 11902–11904.

10638 NEUTRON SELF-ABSORPTION IN ACTIVATION ANALYSIS. Gruber, E. (Univ., Vienna). Z. Anal. Chem.; 263: No. 3, 194-202(1973). (In German).

Models were developed for the estimation of the influence of self-absorption in the irradiation with neutrons. A parabolic approximation permits the determination of the effect of neutron flux depression, so that its influence in practical activation analysis can be taken into account. Comparison with the results of other workers shows good agreement. The maximum flux depression can be determined by means of the equations, diagrams and tables for any usual material with approximately known composition. (GE)

10639 INSTRUMENTAL NEUTRON-ACTIVATION ANALYSIS OF ROCKS DEMONSTRATED ON 7 STANDARD ROCKS OF THE US GEOLOGICAL SURVEY. Schock, H. H. (Univ., Tuebingen, Ger.). Z. Anal. Chem.; 263: No. 2, 100-107(1973). (In German).

From third seminar on activation analysis; Leopoldschafen, Germany (30 May 1972).

By means of instrumental neutron activation analysis the elements Sc, Cr, Co, Rb, Sb, Cs, La, Ce, Nd, Eu, Tb, Yb, Lu, Hf, Ta, and Th were determined in the standard rocks G-2, GSP-1, AGV-1, PCC-1, DTS-1, BCR-1, and W-1 of the US Geological Survey. These standard rocks are sufficiently homogeneous, as regards their trace element distribution, to be used as multielement standards in most analyses of geological material. (GE)

10640 DETERMINATION OF RARE EARTH ELEMENT DISTRIBUTION PATTERNS IN ROCKS AND MINERALS BY NEUTRON-ACTIVATION ANALYSIS. Potts, M. J.; Earlym, T. O.; Herrmann, A. G. (Univ., Goettingen, Ger.). Z. Anal. Chem.; 263: No. 2, 97-100(1973).

From third seminar on activation analysis; Leopoldshafen, Germany (30 May 1972).

A routine procedure for determining eleven of the fourteen naturally occurring rare earth elements (REE) in rocks and minerals is described. Following thermal neutron activation the samples are decomposed, by fusion with Na_2O_2. After the REE are separated as a group they are then counted with a high resolution Ge(Li) spectrometer system. Chemical yields are determined by reirradiation and counting of the carrier. The high precision and accuracy of the technique have been proven through replicate analyses and through analyses of the U. S. Geological Survey standard rock, W-1. The technique, with slight modifications, has been tested to date on more than a hundred rock and mineral samples. Experience has shown that the eleven REE determined by this technique more than adequately describe the total distribution patterns for the REE in naturally occurring samples. (GE)

10641 SOME USES OF NEUTRONS FROM NON-REACTOR SOURCES FOR THE EXAMINATION OF METALS AND ALLIED MATERIALS. Pierce, T. B. (Atomic Energy Research Establishment, Harwell, Eng.). pp 49-61 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From Symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

Neutron transmission can be applied to the examination of samples of well-defined composition and requires only simple instrumentation. Although non-specific, it can provide measurement of elements with high scattering and absorption cross-sections and the rapid response is attractive for control purposes. By using a system based on a 300-mCi Am–Be source, boron was determined in alloys and compacts, at the rate of 1 sample every 100 seconds, and the spatial distribution of components of low transmission present in a matrix of high transmission has been followed by scanning with a carefully collimated isotope source neutron beam. Activation analysis with radioisotope sources is attractive for control purposes since the reliability of the source is guaranteed, but the limited strengths of sources generally available have restricted their application. The recent availability of ^{252}Cf has extended the scope of activation analysis with isotope sources; a facility has been constructed in the Analytical Sciences Division at Harwell in which eight ^{252}Cf sources are situated round the sample to reduce flux gradients during irradiation. The continuous operation of the neutron source is exploited by using an automatic sample transfer and data acquisition system; samples are placed in a magazine and can be passed through the activation and measurement cycle without the need for the presence of an operator. The system has been applied to the determination of a number of elements in a range of metals, alloys and raw materials. High energy neutrons from a neutron generator can induce highly endoergic reactions such as $^{16}O(n,p)^{16}N$ and $^{14}N(n,2n)^{13}N$. High-output pumped and sealed tube systems, together with the necessary sample transfer, data acquisitions and data processing systems are in regular use for the determination of elements such as Fe, O, N, Si, Al, F, P, Cr and Cu in metals, alloys, refractories and minerals. (auth)

10642 UTILIZATION OF FAST-NEUTRON ACTIVATION ANALYSIS IN THE ALUMINIUM INDUSTRY. Mukai, K.; Takano, K.; Takada, K. (Nippon Light Metal Research Laboratory Ltd., Shizuoka, Japan). pp 63-71 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

Fast-neutron activation analysis has been investigated since 1964 for making such determinations and a Toshiba NAT-200 Cockcroft–Walton type neutron generator, named "Activac", was installed in 1966. Rapid and nondestructive analysis is performed by this method and a neutron flux of 10^{10} n/s is obtained. The time required for the determination is 90 s, and the determination limit is 0.0003% as oxygen. Relative standard deviations at the oxygen levels of 0.1, 0.01, 0.002, 0.001 and 0.0005% are below ±5, ±10, ±20, ±40 and ±60%, respectively. As this apparatus can be applied to the determination of fluorine, aluminium, sodium and silicon with nuclear reactions (n,p), (n,2n) and (n,α), it has been used for the determinations of principal elements in fluoride compounds, and the oxygen in the electrolyte of an aluminium reduction pot. The following practical applications are also described: (1) determination of oxygen in various aluminium alloys, (2) change of oxygen content in molten aluminium alloys according to holding time and also during various processes in a holding furnace, (3) improvement of the quality of aluminium casting alloys from the viewpoint of oxygen content, and (4) correlation between the oxygen and hydrogen contents in ingots. (auth)

10643 USE OF PROMPT NUCLEAR AND ATOMIC REACTIONS IN THE ANALYSIS OF METAL SAMPLES. Deconninck, G.; Demortier, G. (Facultes Univ., Namur, Belgium). pp 573-589 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973). (In French)

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

A method of analyzing metal samples by prompt atomic and nuclear reactions caused by protons and ^3He ions inducing x and γ-ray fluorescence is described. The method is applied to quantitative analysis. Several examples are given, and the sensitivity and speed of the technique are discussed in each case: stainless steels, alloys of precious metals, aluminium in heavy metals, alloys in dentistry, Rh and Pt in rhodic platinum, and traces of Fe, Cu and Zn in aluminium. The method is nondestructive and no residual activity is observed. (auth)

10644 MAGNESIUM INTERFERENCE IN THE DETERMINATION OF SODIUM IN BIOLOGICAL MATERIAL BY NEUTRON ACTIVATION ANALYSIS. Singh, J.; Dieckert, J. W. (Texas A and M Univ., College Station). Anal. Biochem.; 53: No. 2, 470-477(Jun 1973).

Irradiation of $MgSO_4$ in a neutron flux with a thermal neutrons to fast neutrons ratio of 12.1:1 resulted in the production of 0.65 μg of Na per mg of Mg. Using this constant and the Mg content of the peanut sample the Mg contribution to the observed Na was estimated. Such estimates revealed that in some peanut tissues Mg contribution accounted for as much as 42% of the total observed Na. (auth)

10645 ACTIVATION ANALYSIS. Hoste, J.; Op De Beeck, J.; Gijgels, R.; Adams, F.; Van Den Winkel, P.; De Soete, D. Cleveland; Chemical Rubber Company (1971). 148p.

This book is one volume of the CRC Monotopics Series, the objective of which is to provide authoritative and comprehensive summaries of the "state-of-the-art" of a single well-defined subject. The five chapter titles are: instrumental neutron activation analyses; computer applications; radiochemical separations; activation analysis with neutron generators; and photon and charged particle activation analysis. The two addenda treat recent advances in instrumental neutron activation analysis and computer applications. (600 references) (JGB)

10646 TRACE ELEMENT TRAPPING IN PTEROPOD TESTS. Turekian, K. K.; Katz, A.; Chan, L. (Yale Univ., New Haven). Limnol. Oceanogr.; 18: No. 2, 240-249(Mar 1973).

Pteropod tests from the Gulf of Aqaba and the South Atlantic Ocean and bulk (soft tissue) plankton samples from Long Island Sound were analyzed by instrumental neutron activation analysis (INAA) for 11 trace metals (Fe, Ce, La, Sm, Eu, Th, Sc, Cr, Co, Sb, and Se) to study the trapping and transport mechanisms for these metals in the oceans and the capability of pteropods to modify the composition of seawater during this process. The internal correlations among these metals strongly suggest that a finely particulate (<0.2 μ) authigenic iron-rich phase (hydrated oxide or phosphate) is trapped by both the soft and hard tissues of plankton and that this phase is the major carrier of several of the trace metals. Assuming that the iron-rich floc-trapping mechanism is applicable to all pelagic calcareous tests, then the downward flux of iron and associated trace elements carried by these tests can be assessed. To the precision of our knowledge about the transport and dissolution of calcium carbonate in deep water, this assumption leads to the conclusion that the iron and the associated trace elements have residence times in the deep water of the same order of magnitude as that of the deep water itself. (auth)

10647 THORIUM IN WATER AND ALGAE FROM THE ADRIATIC SEA. Strohal, P.; Pinter, T. (Rudjer Boskovic Inst., Rovinj, Yugoslavia). Limnol. Oceanorg.; 18: No. 2, 250-253 (Mar 1973).

Thorium concentrations were determined in filtered (0.45-μ Millipore) and unfiltered seawater as well as in marine algae. In filtered seawater, values were 8×10^{-13} g Th liter^{-1} and lower; for unfiltered seawater samples, values about three orders of magnitude higher were obtained. Thorium concentrations in marine algae are in the range of 10^{-6} to 10^{-8} g Th g^{-1} ashed material. (auth)

10648 ROLE OF TRI- AND DIMETHYLSILANES IN TAILORING CHROMATOGRAPHIC ADSORBENTS. Gilpin, R. K.; Burke, M. F. (Univ. of Arizona, Tucson). Anal. Chem.; 45: No. 8, 1383-1389(Jul 1973).

The reactions of trimethylchlorosilane (TMCS) and dimethyldichlorosilane (DMCS) with the porous silica adsorbents marketed under the trade name of Porasil (Waters Associates, Farmington, Mass.) are discussed. The effects of pre-reaction surface dehydration and the effective area available for bonding were examined. A correlation between these bonding areas and nitrogen surface data is presented. In addition, the secondary reactions of short-chained alcohols with dimethyldichlorosilane-treated silica adsorbents were investigated. These reactions were followed by means of thermal neutron activation and microcarbon analysis. In light of these data, a physical "picture" of the surface as well as a mechanism for the reaction is suggested. (auth)

10649 INSTRUMENTAL PHOTON ACTIVATION ANALYSIS OF ATMOSPHERIC PARTICULATE MATERIAL. Aras, N. K. (Univ. of Maryland, College Park); Zoller, W. H.; Gordon, G. E.; Lutz, G. J. Contract AT(40-1)-4028. Anal. Chem.; 45: No. 8, 1481-1490(Jul 1973).

Concentrations of fourteen elements in atmospheric particulate matter were measured by irradiation of the samples with bremsstrahlung from electrons of 35 MeV from the National Bureau of Standards electron linac and observation of γ rays from the reaction products with Ge(Li) detectors. The elements routinely observed by this nondestructive method are: Na, Cl, Ca, Ti, Cr, Ni, Zn, As, Br, Zr, Sb, I, Ce, and Pb. Several other elements such as Fe, Se, Rb, and Y are marginally observable. Although, in general, instrumental photon activation analysis (IPAA) is less sensitive than instrumental neutron activation analysis (INAA), with IPAA one can measure concentrations of several elements that are difficult or impossible to measure in urban particulates with INAA, especially Ti, Ni, As, I, and Pb. Measurements of Ni, As, and Pb are quite important because of their known toxicities. (auth)

10650 TECHNIQUES FOR MONITORING THE QUALITY OF ULTRAPURE REAGENTS: NEUTRON ACTIVATION AND X-RAY FLUORESCENCE. Mitchell, J. W.; Luke, C. L.; Northover, W. R. (Bell Telephone Labs., Murray Hill, NJ). Anal. Chem.; 45: No. 8, 1503-1506(Jul 1973).

Reagents distributed by several commercial suppliers as electronic or ultrapure chemicals were analyzed quantitatively by instrumental neutron activation to determine total concentrations of sodium, chlorine, copper, and manganese impurities. Data obtained in this way for the analysis of ultrapure nitric, acetic, hydrofluoric acids, hydrogen peroxide, and ammonium hydroxide show reagents much purer than corresponding reagent grades. However, comparisons of these data with quotations of purity provided by suppliers showed several discrepancies. A sensitive x-ray fluorescence method is also described for the determination of trace transition elements in particulates separated from various commercially available, high purity, water soluble salts. Evidence of significant contamination of pure salts by iron in particulate form is reported. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 10684, 10941, 10943, 10944, 10950, 11494, 11533, 11535, 11543, and 12574.

10651 (BARC-648) SPECTROGRAPHIC ANALYSIS OF TANTALUM OXIDE: (A) AN INTERMITTENT A. C. ARC METHOD; (B) A D. C. ARC METHOD. Chandola, L. C.; Venkatasubramanian, R.; Dixit, V. S. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 38p. Dep. NTIS (U. S. Sales Only) $4.00.

Two spectrographic procedures are described for the analysis of tantalum oxide. These are an intermittent ac arc method and a dc arc method. In the first method, the sample is glued to the flat tops of a pair of graphite electrodes and excited by a Hilger's low voltage intermittent ac arc source at 6 amperes current. In the second method, the sample is mixed with zinc oxide and graphite in the ratio 1:1:1 and excited in a dc arc at 15 amperes current in the cup of a graphite electrode using a pointed electrode as a counter. In both the methods, the spectra are photographed on a JACO 3.4 metre grating spectrograph using the first order of a 1200 grooves/mm grating blazed at 3300 Å in the region 2300 to 3500 Å. Niobium can be estimated to a lower limit of 40 ppM using the line Nb 2950.87 Å. Other elements estimated simultaneously are aluminium, iron, lead, manganese, molybdenum, nickel, silicon, tin, titanium, vanadium, and zirconium. The precision of intermittent ac arc method was found to be ±12% while that of dc arc method ± 21%. The dc arc method serves as an alternative method in case a low voltage intermittent ac arc source is not available. (auth)

10652 (CONF-730613-4) SIMPLE, QUANTITATIVE X-RAY FLUORESCENT ANALYSIS FOR TRACE ELEMENTS. Sparks, C. J. Jr.; Cavin, O. B.; Harris, L. A.; Ogle, J. C. (Oak Ridge National Lab., Tenn.). 1973. 20p. Dep. NTIS $3.00.

From 7th annual conference on trace substances in environmental health; Columbia, Missouri, USA (12 Jun 1973).

The application of x-ray fluorescence analysis (XRF) for the determination of trace elements offers cheap, rapid, quantitative analysis without time consuming prior chemical concentration or alterations. The x-ray fluorescent system presented here uses a monochromatic source of x-rays and a solid state detector energy analyzing system capable of detection limits exceeding one part per million (ppM) by weight for heavy elements to 10 ppM for lighter elements in a variety of samples of interest to the environmentalist. Included were analyses of coal and leaves for Sr. Monochromation by diffraction gives a monoenergetic source for excitation, which improves detectability compared to the systems using white radiation or transmission target x-ray tubes. Direct calculations of elemental concentrations without preparation of standards or known additions are possible with monochromatic x rays at precisions comparable to other techniques. A description of the XRF unit and examples of its application for quantitative analysis are given. Techniques under development for the detection of trace elements to a few parts per billion (ppB) are described. (auth)

10653 (NP-19774, pp B51-B56) THORIUM DISTRIBUTION IN A GRANITE STOCK NEAR BULL CANYON, LEMHI COUNTY,

IDAHO. Staatz, M. H. (Geological Survey, Denver); Bunker, C. M.; Bush, C. A. 1972.

In geological survey research, 1972.

A granite stock underlying an area of about 4.3 square miles occurs on the west side of the Beaverhead Mountains near Bull Canyon, Idaho. This granite body, which is of probable Silurian age, has intruded both the upper Precambrian Belt Supergroup and the Ordovician Kinnikinic Quartzite. The granite consists principally of perthite and quartz with minor amounts of plagioclase, magnetite, biotite, zircon, apatite, rutile, monazite, and allanite. The average thorium content of 16 representative samples from various parts of the stock is 35 ppm. A radiometric map of the granite stock indicates that the most radioactive area occurs along an arcuate ridge near the east edge of the stock. The most radioactive parts of this area are in widely scattered zones along fractures and in small irregular areas. In these abnormally radioactive areas, which may contain in excess of 100 ppm Th, the principal thorium mineral is thorite, which occurs as tiny crystals along fractures. Late-stage postmagmatic fluids are believed to have altered the original granite and deposited the thorite along favorable zones. (auth)

10654 (NP-19774, pp B157-B164) CHEMICAL ANALYSIS OF RUTILE: DIRECT SPECTROPHOTOMETRIC DETERMINATION OF TITANIUM, TOTAL IRON, NIOBIUM, PHOSPHORUS, AND VANADIUM. Meyrowitz, R. (Geological Survey, Washington, DC). 1972.

In geological survey research, 1972.

Titanium, total iron, niobium, phosphorus, and vanadium are directly determined in rutile using hydrogen peroxide, 1,10-phenanthroline, 4-(2-pyridylazo)-resorcinol[PAR], heteropoly blue, and phosphotungstovanadate procedures, respectively. One part of each sample is decomposed by potassium pyrosulfate fusion in a transparent quartz crucible, and a sulfuric acid solution of the melt is used for the determination of titanium, iron, niobium, and phosphorus. A second part is decomposed by sodium carbonate fusion in a platinum crucible, and a sulfuric acid solution of the melt is used for the determination of vanadium. The elements commonly present in rutile do not interfere in the determination of titanium, iron, and phosphorus. Titanium and iron interference in the determination of niobium is eliminated by adding the titanium and iron contents of the sample to the standard niobium solutions used for the standard niobium curve. Similarly, iron interference in the determination of vanadium is overcome by adding the iron content of the sample to the standard vanadium solutions used for the standard vanadium curve. (auth)

10655 ATOMIC-ABSORPTION DETERMINATION OF IRIDIUM AND RUTHENIUM. Lanbina, T. V.; Yudelevich, I. G.; Vasil'eva, A. A.; Zubkova, T. N.; Abakumov, D. N. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, No. 2, Ser. Khim. Nauk; No. 4, 82-87(Mar 1973). (In Russian).

The influence of noble and some unnoble metals on the atomic absorption determination of iridium and ruthenium was studied. It was found, that nitrate salts of lanthanum or neodymium (1% La or Nd in the final volume of solution) should suppress interfering elements. The sensitivity of the determination of Ru is about 0.5 mg/ml and for Ir, 4 mg/ml. The effects of form and degree of oxidation of iridium and ruthenium on their atomic absorption were studied. It was found that the atomic absorption of Ir(IV) is greater than that of Ir(III). The results were applied to the analysis of products of complex composition for Ru. Coefficient of variation of Ru (1 mg/ml) is 4.7%. (auth)

10656 N-METHYL SALICYLHYDROXAMIC ACID AS A COMPLEXING REAGENT. Ghosh, N. N.; Mukherjee, A. (University Coll. of Science, Calcutta). Sci. Cult. (Calcutta); 38: No. 10, 457-458(Oct 1972).

N-methyl salicylhydroxamic acid (RH_2) forms a number of colored complexes with U(VI) at different pH values. At pH ≈ 6.0 to 7.0, the formation of a water-soluble yellow complex permits the spectrophotometric determination of U(VI) in aqueous solution. In order to estimate U(VI) with RH_2, the optimum pH range is 6.0 to 7.0, and the moles of RH_2 should be present more than 40 times that of U(VI). The maximum color intensity develops after 10 min from the time of mixing and the intensity has been retained even after 24 hrs at room temperature. U(VI) from 67 to 3 ppM can be accurately measured at the selected wavelength 450 nm against water. Extinction coefficient of the yellow complex at 450 nm is 666. Sensitivity is 0.36 μg per cm^2 according to Sandell's notation. Interferences due to diverse ions have also been studied. U(VI) generally gives water-insoluble chelates with aroylhydroxamic acids at lower pH values and the ligands themselves are very sparingly soluble in water. (ERB)

10657 TWIN ION TECHNIQUE FOR DETECTION OF METABOLITES BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY: INTERMEDIATES IN ESTROGEN BIOSYNTHESIS. Braselton, W. E. Jr.; Orr, J. C.; Engel, L. L. (Massachusetts General Hospital, Boston). Anal. Biochem.; 53: No. 1, 64-85(May 1973).

[4-^{14}C + 7-$D_{0.44}$] Androstenedione and [4-^{14}C + 7β-$D_{0.42}$] testosterone were prepared. When they were examined by mass spectrometry, the above proportion of deuterium and protium forms resulted in mass spectra in which the molecular ion (M^+) and ($M^+ + 1$) were of equal intensity. Fragment ions that contained deuterium were also twins. When doubly labeled androstenedione and testosterone were used as substrates for the aromatizing enzymes of human placenta, the mass spectra of metabolites were characteristically labeled and thus readily distinguished from unlabeled material. Metabolites were quantitated by counting ^{14}C. 17β,19-Dihydroxyandrost-4-en-3-one, 19-hydroxyandrost-4-ene-3,17-dione, 17β-hydroxy-3-oxoandrost-4-en-19-al, 3,17-dioxoandrost-4-en-19-al, estradiol-17β, and estrone were isolated, identified by their mass spectra, and quantitated following incubation of doubly-labeled androstenedione and testosterone with human placental microsomes. (auth)

10658 ANALYSIS OF LUNAR SAMPLES 14163, 14259, AND 14321 WITH ISOTOPIC DATA FOR ^{7}Li/^{6}Li. Strasheim, A.; Jackson, P. F. S.; Coetzee, J. H. J.; Strelow, F. W. E.; Wybenga, F. T.; Gricius, A. J.; Kokot, M. L.; Scott, R. H. (CSIR, Pretoria). Geochim. Cosmochim. Acta; Suppl. 3: 1337-1342(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

The lunar samples 14163,151, 14259,77, and 14321,222 were analyzed comprehensively by several analytical methods, including wet chemical techniques and various instrumental methods. The values obtained by these methods are presented, including the spark-source mass spectrographic values obtained for the forsteritic olivine which was heterogeneously distributed in sample 14321. The ^{7}Li/^{6}Li ratio was also determined using a laser-source mass spectrometer. (auth)

10659 GAMMA SPECTROMETRIC FAST DETERMINATION OF THORIUM IN TUNGSTEN WELDING ELECTRODES. Ortner, H. M. (Metallwerk Plansee, Reutte/Tyrol, Austria). Z. Anal. Chem.; 264: No. 3, 185-192(1973). (In German).

From 1st European conference on analytical chemistry; Heidelberg, Germany (28 Aug 1972).

The method is intended for ThO_2 contents from 1 to 5% in rod-formed tungsten electrodes. Gamma-spectrometric activity measurements can be carried out by use of a simple single-channel gamma spectrometer with NaI(Tl) well crystal. The most favorable measuring range includes γ energies from 30 to 500 keV. According to respective ThO_2 contents and electrode diameters, counting times 5 to 40 sec are sufficient. A chemical calibration analysis is necessary each time a new ThO_2 batch is used in electrode production. Reliable measurements are attained only after a one week period after sintering of the electrodes. This, however, appears to be no serious disadvantage for a final control of electrodes. Investigations were also carried out concerning the radial and longitudinal ThO_2 distribution of various electrodes. (GE)

10660 EXTRACTION ATOMIC ABSORPTION METHOD FOR DETERMINATION OF MOLYBDENUM IN SOLUTIONS. Yudelevich, I. G.; Shaburova, V. P.; Torgov, V. G. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk USSR, No. 2, Ser. Khim. Nauk; No. 4, 79-82(Mar 1973). (In Russian).

The effect of a number of elements on molybdenum absorption in an acetylene–air flame was studied. A study was made of the molybdenum extraction with a α-n-nonylpyridine N oxide (PyOx) solution in toluene from nitric acid, hydrochloric acid, and sulfuric acid solutions and also the effect of impurities on extraction of molybdenum in industrial solutions and on its determination in the organic phase. The results obtained were used for the extraction atomic absorption determination of molybdenum in solutions. Detection limit is of 0.5 ppM for an acetylene–air flame and 0.02 ppM for a N_2O–acetylene flame. (auth)

10661 THERMODYNAMIC APPROACH TO THE QUANTITATIVE INTERPRETATION OF SPUTTERED ION MASS SPECTRA. Andersen, C. A.; Hinthorne, J. R. (Hasler Research Center, Goleta, CA). Anal. Chem.; 45: No. 8, 1421-1438(Jul 1973).

An analytical method has been developed for quantitative sputtered ion mass analysis with the ion microprobe mass analyzer. The method involves the use of reactive gases in the primary bombarding ion beam to enhance and control the emission of sputtered ions from the sample and the use of a theoretical correction procedure to convert the sputtered ion intensities to

quantitative elemental analyses. The correction procedure is based on a thermal equilibrium model of the sputtering ion region that permits the relative numbers of positive and negative ions, of neutral atoms, and of oxide molecules to be calculated using simple dissociation reactions and the well established Saha relationships. The theoretical correction procedure was tested as a practical method with favorable results on the analyses of over one hundred standard reference materials ranging from insulators to metals for over thirty elements spanning the major to trace element concentration range, and including Mo, Nb, Ce, La, Ru, Te, Sr, Y, Zr, and Cs. (auth)

10662 NEW X.R.F. DATA RETRIEVAL TECHNIQUES AND THEIR APPLICATION TO U.S.G.S. STANDARD ROCKS. Brown, G. C. (Univ. of Liverpool, Eng.); Hughes, D. J.; Esson, J. Chem. Geol.; 11: No. 3, 223-229(Jun 1973).

Accurate and consistent x-ray fluorescence analysis of major and trace elements using a single pressed pellet for each sample was achieved with a wide variety of rock compositions. Counting techniques for use with data reduction and correction programs in Standard Fortran IV are described; the latter depend throughout on data developed from a wide range of standard rock compositions. A comparison of ten major and fifteen trace element analyses for U.S.G.S. standard rocks with averages taken from the literature testifies to the precision of these techniques. These elements included Ce, Nd, La, Y, Rb, Sr, Ba, Zr, Ti, Ni, Cr, V, Sc, Zn, and Cu. (auth)

10663 PROPAGATION OF EXPERIMENTAL ERRORS IN LEAD ISOTOPE RATIO MEASUREMENTS USING THE DOUBLE SPIKE METHOD. Cumming, G. L. (Univ. of Alberta, Edmonton). Chem. Geol.; 11: No. 3, 157-165(Jun 1973).

Computer simulation of random errors in the measurements for the double spike technique applied to Pb isotope analyses, indicates that normalized error multiplication factors for the calculated values of isotope ratios lie in the range 2 to 3. The optimum isotopic composition of the tracer is about $^{207}Pb/^{204}Pb = 2.0$ and the optimum ratio of amount of tracer to amount of unknown is about $P = 1.0$. Determination of errors in the fractionation factor alone does not adequately describe the ultimate errors in the calculated isotope ratios except under special circumstances. Uncertainty in the actual composition of the tracer is closely proportional to uncertainty in the unknown composition. The purity of the spike is unimportant at least as long as the separated ^{207}Pb and ^{204}Pb isotopes are greater than 90% pure. (auth)

10664 SIMULTANEOUS SPECTROGRAPH DETERMINATION OF TIN AND MOLYBDENUM IN ROCKS AND ROCK-FORMING MINERALS. Gvaramadze, N. D. (Geological Inst., Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 70: No. 2, 325-328 (May 1973). (In Russian).

Experiments were conducted with a view to establishing the best composition of the buffer mixture, as well as the dilution ratio of the specimen under analysis, optimum conditions of analysis and so on. Tin and molybdenum evaporation curves were built in order to determine the time of exposition and to control the reference powders. As a result a method was evolved for simultaneous determination of tin and molybdenum in rocks and rock-forming minerals. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 10764, 10766, 10871, 11076, 11118, 11119, 11516, 11517, and 11525.

10665 (NP-19774, pp B147-B150) X-RAY FLUORESCENCE DETERMINATION OF ARSENIC, ANTIMONY, NICKEL, RUBIDIUM, SCANDIUM, VANADIUM, AND ZINC IN ROCK STANDARDS AND OTHER ROCK SAMPLES. Fabbi, B. P.; Espos, L. F. (Geological Survey, Menlo Park, CA). 1972).

In geological survey research, 1972.

Arsenic, antimony, nickel, rubidium, scandium, vanadium, and zinc were determined in 18 rock standards and eight rock samples, making corrections for matrix and interelement effects where necessary. Detection limits for these elements are 3 to 70 ppm. X-ray fluorescence values obtained are in good agreement with the preferred or chemical values. (auth)

10666 (TID-26209) BURNUP DETERMINATION FOR FAST REACTOR FUELS: REVIEW AND STATUS OF THE NUCLEAR DATA AND ANALYTICAL CHEMISTRY METHODOLOGY REQUIREMENTS. Maeck, W. J.; Larsen, R. P.; Rein, J. E. (Allied Chemical Corp., Idaho Falls, Idaho. Idaho Chemical Programs Operations Office; Argonne National Lab., ILL; Los Alamos Scientific Lab., N. Mex.). Feb 1973. 87p. Dep. NTIS $5.45.

The determination of nuclear fuel burnup in the USAEC Fast Breeder Reactor Program is reviewed. A discussion is presented of the relative advantages and disadvantages of burnup determinations that are based on measurements of (1) the fission product and residual heavy atom contents of the irradiated fuel, (2) the heavy atom isotopic ratios of the irradiated and unirradiated fuel, and (3) the heavy atom contents of irradiated and unirradiated fuel. It is concluded that the fission product-residual heavy atom technique is applicable to a wider variety of irradiated fuels than other techniques and is the only one that can provide the accuracy required in the Fast Breeder Program. The current status of fast reactor nuclear data and analytical chemistry methodology is discussed. The integrated effort of three laboratories, the Idaho Processing Plant (Allied Chemical Corporation), the Argonne National Laboratory, and the Los Alamos Scientific Laboratory to accurately measure fast fission yields and other fast reactor nuclear data, to improve the existing analytical methods and develop new ones, and to develop reliable burnup measurement methods is presented. (auth)

10667 COMPARISON OF NCS SOLUBILIZATION AND A WET COMBUSTION TECHNIQUE FOR ^{14}C MEASUREMENT IN DRIED BIOLOGICAL TISSUES. Wheeler, L.; Strother, A. (Loma Linda Univ., CA). Anal. Biochem.; 53: No. 1, 42-48(May 1973).

Two techniques, NCS solubilization and wet combustion, were found to be equal in their ability to measure the ^{14}C present in various dried rat tissues. Larger tissue samples with higher efficiencies were possible with wet combustion but it was inadequate for ring-labeled [^{14}C]carbaryl; it also requires constant supervision by personnel in addition to being very time consuming. NCS solubilization is much more rapid and capable of quantitative recoveries of ring- and carbonyl-labeled carbaryl. NCS seems to be a more rapid alternative when sufficient ^{14}C is present in tissue for analysis. (auth)

10668 RADIOISOTOPE X-RAY TECHNIQUES FOR THE ON-STREAM DETERMINATION OF LOW CONCENTRATIONS OF COPPER, ZINC, TIN AND LEAD IN MINERAL SLURRIES. Watt, J. S.; Fookes, R. A.; Gravitis, V. L. (Australian Atomic Energy Commission, Sydney). pp 141-153 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

Radioisotope x-ray techniques have been developed for the determination of copper, zinc, tin, and lead in tailings streams. The concentration of the elements to be determined in the tailing solids is usually within the range 0.05 to 1 wt %, and precisions required for plant control range from 0.01 to 0.05 wt %. Copper is determined by x-ray fluorescence (XRF) analysis. The choice between use of direct excitation, γ-ray excited x-ray source, and detector-radiator assemblies depends in practice on particle size effects, the presence of higher atomic number elements such as zinc and lead, and the relative concentration of iron and copper in the tailings. Detector-radiator assemblies discriminate well against iron K x-rays, and have made it possible to use scintillation detectors for the analysis of tailings having high concentrations of iron. Count rates are often low for tailings analyses when commercially available ^{238}Pu sources are used in XRF assemblies. Curium-244 sources have been developed to increase count rates by a factor of 10. Copper was determined in solid samples taken from tailing streams in four mineral processing plants. Tailings from Peko Mines contain about 50% iron and 0.3% copper, and were analysed using detector-radiator assemblies. Bougainville Copper tailings contain only about 10% iron by weight and have a coarser grain size, and direct excitation gives a precision of 0.01% copper. Cobar Mines tailings contain 28% iron, 3% zinc, 1% lead and 0.2% copper, and direct excitation gives a precision of 0.02% copper. Zinc, tin and lead have been determined in both solid samples and in plant tailings streams, and precisions better than required for plant control purposes were achieved in all cases. (auth)

10669 INDUSTRIAL ON-STREAM ANALYSIS USING GAMMA-RAY RESONANCE SCATTERING. Sowerby, B. D.; Ellis, W. K. (Australian Atomic Energy Commission). pp 479-492 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB/-314; CONF-720704-.

A technique for industrial on-stream determination of a wanted element in bulk samples was developed. This technique is well suited to the analysis of ore on a conveyor belt, particularly for the elements Cu and Ni. Measurement is made using the γ-ray resonance scattering process. A radioisotope is chosen so that in the gaseous state its γ rays resonantly scatter via an

excited nuclear state of the wanted element. Thus the process is highly specific to this element. Also the resonantly scattered γ rays have very nearly the same energy as the incident γ rays and are therefore easily separated from the more abundant lower-energy Compton and pair production γ rays. The elements Cu, Ni, Tl and As were successfully measured on simulated conveyor belts using gaseous radioisotope sources of $^{65}Zn\ I_2$, $^{60}Co\ Br_2$, $^{46}Sc\ Cl_3$ and $^{75}Se\ O_2$ respectively. The resonance photopeak count rate for a sample of 1% Cu was 10 counts/sec per 10 curies of ^{65}Zn. The corresponding lower-energy count rate was 650 counts/sec, most of it below 500 keV. The count rate from other elastic scattering processes was negligible. For a 1% Ni sample the resonance and lower-energy count rates were 2 and 590 counts per second respectively. The resonance count rate can be increased by a factor of 10 if a higher proportion of lower-energy γ rays can be tolerated. The allowable proportion of lower-energy γ rays will depend on the specific application. The corrections to these count rates for changes in sample density, thickness and location are discussed and compared with calculation. The various methods of on-stream analysis of bulk samples are compared. For the measurements of Cu or Ni (or other elements with favorable resonance cross-section and readily available radioisotope sources) it is shown that the resonance scattering method is preferable to the alternative neutron activation and capture methods. The resonance method is faster, suffers no inter-element interference and would use simpler equipment of lower cost. (auth)

10670 PROTON AND ALPHA PARTICLE INDUCED X-RAY EMISSION AS A PROPOSED SURFACE TRACE ANALYSIS TOOL. McCoy, J. D. (Univ. of Tulsa, OK); Duggan, J. L.; Robinson, E. L.; Cipolla, S. J. pp 509-611 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

X-ray production for K shell cross-sections were measured for Ni, Fe, Ti, Ge, Rb, and Zr at incident proton energies from 1 to 6 MeV. Cross-sections were also measured for Ca, Fe, Co, Ni, Cu, and Ag for alpha particles in the range from 1 to 12 MeV. The charged particles were produced with a Van de Graaff accelerator and the characteristic K x-rays were measured with one of the new high-resolution (166 eV) Si(Li) x-ray detectors. The measured experimental cross-sections have been compared to the theoretical predictions of the Plane Wave Born Approximation (PWBA) and the results indicate that the PWBA theory does a fairly good job of describing the interaction in the energy range from 4 to 12 MeV. The differential cross-sections were found to be, for the most part, many orders of magnitude higher than corresponding nuclear cross-sections with the same projectile and target system. For example, the Ni-K_α production cross-section is about 10^3 barns at an incident alpha particle energy of 10 MeV. As a consequence of these high-production cross-sections, this technique can be used to study surface trace contamination with sensitivities that are competitive with most other analytic techniques. In addition, the accelerator energy and ion type can be changed to study concentration of a particular contaminant as a function of surface depth. The application of low voltage Cockcroft-Walton accelerators for this same type of measurement will also be outlined. (auth)

10671 SCINT: A FORTRAN IV PROGRAM FOR THE ANALYSIS OF DATA FROM DOUBLY LABELED AND VARIABLY QUENCHED LIQUID SCINTILLATION SAMPLES. Boekx, R. L.; Protti, J.; Dakshinamurti, K. (Univ. of Manitoba, Winnipeg, Can.). Anal. Biochem.; 53: No. 2, 491-508(Jun 1973).

The development of SCINT, a simple and versatile program written in FORTRAN IV for use on Control Data 1700 computer facility, is reported. The computer program calculates microcuries of ^{14}C and ^{3}H, picomoles/ml ^{14}C and ^{3}H, and the ratio of ^{14}C (picomoles/ml)/^{3}H (picomoles/ml). The program is particularly applicable for use with experimental procedures involving column chromatography of doubly labeled materials, with the plot being in the format of the usual elution diagram. (DHM)

10672 SEPARATION OF WATER FROM BIOLOGICAL AND ENVIRONMENTAL SAMPLES FOR TRITIUM ANALYSIS. Moghissi, A. A.; Bretthauer, E. W.; Compton, E. H. (National Environmental Research Center, Las Vegas, NV). Anal. Chem.; 45: No. 8, 1565-1566(Jul 1973).

Benzene was used as the co-distillate in the azeotropic distillation of water from biological and environmental samples prior to tritium determination. Samples were counted in a liquid scintillation counter. Results of the azeotropic distillation were compared with those from regular and vacuum distillation methods. Precision, accuracy, and isotope effect were found to be well within limits. (JGB)

Separation Procedures

Refer also to abstracts 10741, 10748, and 10749.

10673 (IS-T-595) ANALOG-DIGITAL SIMULATION OF PULSE COLUMN CONTROL CHARACTERISTICS. Kelly, A. M. (Ames Lab., Iowa). May 1973. Contract W-7405-eng-82. 59p. Dep. NTIS $5.00.

Thesis.

The development of a predictive control scheme for the pulse column is reported. An analog simulation, developed from laboratory pulse column data, was used to study the control characteristics of the column. A predictive control scheme consisting of a steady state gain term, and a dynamic compensation term, was used. A feedback trimmer was added to compensate for offset and for random input disturbances not detected by the monitor on the input stream. A small digital computer was used to implement the control algorithm. Direct digital feedback control gave results similar to those obtainable by continuous control. Direct digital predictive control gave much better control than feedback control alone. The direct digital predictive control scheme was able to control multiple and ramp upsets of the pulse column. (auth)

10674 DISTRIBUTION, SEPARATION, AND SALTING OUT DIAGRAMS OF THE $Nd(NO_3)_3-HNO_3-H_2O-(C_4H_9O)_3PO$ SYSTEM. Nikolaev, A. V.; Kolesnikov, A. A.; Antonyants, I. A. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, No. 2, Ser. Khim. Nauk; No. 4, 26-32(Mar 1973). (In Russian).

The combined extraction of neodymium nitrate and nitric acid by pure tributyl phosphate at 25°C was studied. Neodymium nitrate at nitric acid concentrations of less than 50 weight % extracted better than praseodymium, but less than nitric acid. With the concentration of nitric acid more than 50 weight % neodymium nitrate is extracted better than praseodymium or nitric acid. (auth)

10675 ASHING PROCEDURES FOR VOLATILE ELEMENTS IN BIOMATERIALS. Doshi, G. R.; Patel, B. (Bhabha Atomic Research Centre, Bombay). Curr. Sci. (India); 42: No. 9, 307-309(5 May 1973).

Loss of Hg, Se, As, Sb, Cr, Ru, and W during the ashing of soft animal tissues by dry and wet methods was studied by tracer injection of the metals and subsequent ashing and measurement of the radioactivity by γ spectroscopy. Results indicate that dry ashing at 400°C eliminates the more volatile elements, Hg, Se, and As; the other elements partially vaporize at 700°C. Wet digestion under reflux did not cause significant losses of any of the elements. (JGB)

10676 EXTRACTION OF CALCIUM, STRONTIUM, AND BARIUM BY BIS(2-ETHYLHEXYL) PHOSPHATE FROM PERCHLORIC ACID SOLUTIONS. Lanin, V. P.; Smelov, V. S.; Smyk, Z. A. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 690-693(1972).

Translated from Radiokhimiya; 14: No. 5, 667-671(1972).

The extraction of calcium, strontium, and barium from aqueous solutions of perchloric acid using solutions of bis(2-ethylhexyl) phosphate (D2EHPA) is discussed. The values of the equilibrium constants of the investigated processes were calculated. (auth)

10677 EXTRACTION OF SODIUM, RUBIDIUM, AND CESIUM BY BIS(2-ETHYLHEXYL) PHOSPHATE FROM PERCHLORIC ACID SOLUTIONS. Lanin, V. P.; Smelov, V. S.; Smyk, Z. A. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 694-696(1972).

Translated from Radiokhimiya; 14: No. 5, 671-674(1972).

The extraction of sodium, rubidium, and cesium from aqueous perchloric acid solutions using bis(2-ethylhexyl) phosphate is discussed. The equilibrium constants of the investigated processes were calculated. (auth)

10678 COORDINATION CHEMISTRY OF RUTHENIUM IN PROCESSES OF EXTRACTION BY ORGANOPHOSPHORUS COMPOUNDS. Sinitsyn, N. M.; Travkin, V. F.; Borisov, V. V. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 709-713(1972).

Translated from Radiokhimiya; 14: No. 5, 686-692(1972).

The basic principles of the extraction of complexes of nitrosoruthenium coordination-unsaturated with chloro ligands $[RuNOCl_x(OH)_y(H_2O)_{5-(x+y)}]^{3-(x+y)}$ by neutral organophosphorus extraction reagents, trialkylphosphine oxides, were studied. A mechanism of the extraction of chloro complexes of nitrosoruthenium by trialkylphosphine oxides is suggested. It was found that chloro complexes of nitrosoruthenium are extracted better

by trialkylphosphine oxides than the corresponding nitrato complexes of nitrosoruthenium. The coordination compound of ruthenium $[RuNOCl_3(TBPO)_2]$, which is formed in processes of extraction, was isolated in the individual state. The properties and structure of the synthesized compound were studied by various physicochemical methods; the nature of the chemical bond in it is discussed. (auth)

10679 RARE EARTH SEPARATIONS USING CATION-EXCHANGE COLUMN CHROMATOGRAPHY. Comparison of α-Hydroxyisobutyric Acid and α-Hydroxy-α-Methylbutyric Acid as Eluants. Karol, P. J. (Carnegie-Mellon Univ., Pittsburgh). J. Chromatogr.; 79: 287-291(16 May 1973).

Separations of several adjacent rare earth pairs were investigated in order to compare the effectiveness of two eluting agents: α-hydroxyisobutyric acid (αHIBA) and α-hydroxy-α-methylbutyric acid (αHαMBA). The latter was found to be superior for certain rare earth pairs. (auth)

10680 ION-EXCHANGER PAPER CHROMATOGRAPHY OF INORGANIC IONS. XIX. Further Results on the Perchlorate Effect. Manko, R.; Lederer, M. (CNR, Rome). J. Chromatogr.; 79: 305-309(16 May 1973).

R_F values of numerous metal ions including Th(IV), U(VI), La(III), and Ce(III) are given for HCl + 1N $HClO_4$ mixtures on SB-2 resin paper and for HNO_3 + 1N $HClO_4$ on SB-2 and SA-2 papers. Some partition systems formed by impregnating the paper with salt solution and developing with organic solvents were examined for the presence of a "perchlorate effect," but none was observed. (auth)

10681 EXTRACTION OF COMPLEXES OF TRIVALENT LANTHANIDES WITH DIFFERENT AMINOPOLYACETIC ACIDS ON A PRECONDITIONED ION EXCHANGER. Schoebrechts, F.; Merciny, E.; Duyckaerts, G. (Univ., Liege). J. Chromatogr.; 79: 293-304(16 May 1973). (In French).

The anion-exchange resin Dowex 1 X_4 (100 to 200 mesh, Cl^- form) was converted into the HEDTA or NTA form and the fixation of different protonated forms was studied over a wide pH range. The distribution of trivalent lanthanides between these resins and a solution of HEDTA or EDTA was then investigated. The experimental results indicate that the extraction mechanism is a chelating reaction between HEDTA or NTA sorbed on the resin and the 1:1 complex Me(HEDTA) or Me(EDTA) in solution. The kinetics of extraction and the values of HETP obtained are in good agreement with a chelating reaction. (auth)

10682 EXTRACTION OF MOLYBDENUM AND TUNGSTEN FROM BROMIDE SOLUTIONS USING TRIALKYLAMINES. Tseryuta, Yu. S.; Bagreev, V. V.; Zolotov, Yu. A.; Agrinskaya, N. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Neorg. Khim.; 18: No. 6, 1634-1639(Jun 1973). (In Russian).

The extraction of Mo(VI) and W(VI) from bromide solutions using symmetrical trialkylamines with 8 to 12 C atoms was studied. Distribution coefficients of the metals were determined as functions of the concentrations of HBr, amine, metal, and the nature of the diluent. Mo was more readily extracted than W in all cases. It was suggested that the metals were extracted as the singly-charged anions $MeO_2Br_3^-$. (tr-auth)

10683 EXTRACTION OF SCANDIUM AND ACCOMPANYING ELEMENTS FROM SULFATE SOLUTIONS BY TBP. Berezhko, P. G.; Reznik, A. M.; Korovin, S. S.; Ornis, Yu. N. (Moscow Inst. of Fine Chemical Tech.). Zh. Neorg. Khim.; 18: No. 6, 1650-1656 (Jun 1973). (In Russian).

The extraction of Sc from aqueous solutions by TBP and diisoamylmethylphosphonate (DAMP) was investigated. The extraction ability of DAMP relative to the sulfate complexes of Sc was higher than that of TBP. TBP extracted Sc by a hydrate-solvate mechanism as the complexes as $[H^+(H_2O)_m \cdot TBP][Sc(SO_4)_2]^-$ and $TBP \cdot H_2SO_4 \cdot H[Sc(SO_4)_2]$. The extraction of some elements accompanying Sc (Zr, Tl, Yb, Er, Dy, Y, Eu, Nd, Fe, and Al) from H_2SO_4 solutions was also studied. The distribution coefficients of these elements was significantly lower than that of Sc. It was found that Sc may be selectively separated by extraction from H_2SO_4 solutions. (tr-auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 11122, 12544, 12560, and 12571.

Chemical and Physicochemical Properties

Refer also to abstracts 12551–12557.

10684 BIMOLECULAR SELF-REACTION OF PEROXY RADICALS. An Oxygen-18 Isotope Study. Bennett, J. E.; Howard, J. A. J. Amer. Chem. Soc.; 95: No. 12, 4008-4010(13 Jun 1973).

A technique using electron spin resonance spectroscopy was developed to determine the isotopic distribution of the oxygen evolved from the decomposition of an equimolar mixture of the peroxy radicals $R^{16}O^{16}O\cdot$ and $R^{18}O^{18}O\cdot$ (where R was a primary, secondary, or tertiary alkyl, acetyl, or 2-pyridyl group) in an inert solvent. In each case the mixed isotope, $^{16}O^{18}O$, was observed in the oxygen that was evolved in the termination reaction. These results provide additional evidence that the rate controlling termination reaction for the liquid phase autoxidation of hydrocarbons with labile primary, secondary, and tertiary hydrogens involves a head-to-head reaction of two alkylperoxy radicals. (auth)

10685 SOLUBILITY OF BF_3 IN SALTS OF MOLTEN-SALT REACTOR INTEREST. Cantor, S. (Oak Ridge National Lab., TN). Journal of Nuclear Materials; 47: No. 2, 177-186(Jun 1973). (In French).

Using a volumetric method, solubilities of BF_3 were measured in four molten solvents, $LiF-BeF_2$ (66–34 mole %), $LiF-BeF_2-ThF_4-UF_4$ (71.7–16–12–0.23 mole %), $LiF-BeF_2-ThF_4$ (76–12–12 mole %), $LiF-BeF_2-ThF_4-NaF$ (66–15–11–8 mole %). The purposes of the study were (a) to investigate the interaction of BF_3 with fluoride ions in these melts, (b) to aid in evaluating BF_3 in reactor control and in reactor safety. Within the pressure and concentration ranges studied, solubilities obeyed Henry's law. Enthalpies of solution, derived from the temperature dependence of Henry's law constant, varied from –15 to –18 kcal/mole; these large negative values indicate strong chemical interaction between dissolved BF_3 and molten fluorides, most likely the formation of tetrafluoroborate ion, BF_4^-. Entropies of solution were interpreted in terms of the loss of most of the rotational entropy of BF_3. From the observed solubilities, estimates were made of the partial pressures of BF_3 that would occur following accidental mixing of reactor fuel salt with coolant liquid (composition: 92–8 mole % $NaBF_4$–NaF). Barring massive inleakage of coolant into fuel salt, the high solubility of BF_3 in fluoride melts would prevent very high partial pressures of BF_3. The rate of solution of BF_3 was measured in quiesent reactor fuel salt. The results indicate that BF_3 is useful in a control system for "scramming" a molten-salt reactor. (3 tables, 18 references) (auth)

Isotope Effects

Refer also to abstract 10713.

10686 ORIENTATION AND KINETIC SECONDARY ISOTOPE EFFECTS IN THE ADDITION OF 2,4-DINITROBENZENESULFENYL CHLORIDE TO PHENYLALLENE. Izawa, K.; Okuyama, T.; Fueno, T. (Osaka Univ., Toyonaka, Japan). J. Amer. Chem. Soc.; 95: No. 12, 4090-4091(13 Jun 1973).

It was found that 2,4-dinitrobenzenesulfenyl chloride adds to phenylallene to give a 2,3-adduct by a direct rate-determining addition to the terminal bond. Data obtained by experiments on the kinetic secondary isotope effects are further evidence to substantiate the rate-determining 2,3 attack of sulfur forming an intermediate episulfonium ion. The large rate of enhancement (k_H/k_D = 0.84) was observed by γ, γ dideuteration while the α deuteration had essentially no effect on the rate k_H/k_D = 1.01. (DHM)

10687 EXCITED STATE HYDROGEN–DEUTERIUM EXCHANGE AND FLUORESCENCE QUENCHING OF NAPHTHALENE IN SULFURIC ACID SOLUTIONS. Stevens, C. G.; Strickler, S. J. (Univ. of Colorado, Boulder). J. Amer. Chem. Soc.; 95: No. 12, 3922-3928(13 Jun 1973).

The quantum yields of photoinduced hydrogen–deuterium exchange of α- and β-naphthalene-d_1 were measured in moderately concentrated H_2SO_4. In the range of 54 to 67% acid the reactivity of the β position exceeds that at the α position by about 15% in marked contrast to the ground-state results. Fluorescence quenching was measured as a function of acid concentration and temperature; it is found to vary linearly with Hammett acidity and to have an activation energy of about 3 to 5 kcal/mol. A kinetic scheme is proposed in which both quenching and exchange proceed via the formation of a symmetrical intermediate by protonation of the first excited singlet state. (auth)

10688 SULFONIUM SALTS. VII. Halogenation of Thiophane. Studies on the Mechanism of the Pummerer Reaction. Wilson, G. E. Jr.; Albert, R. (Polytechnic Inst. of Brooklyn). J. Org. Chem.; 38: No. 12, 2160-2164(15 Jun 1973).

The effects of solvent and added reagents on the product distributions for the chlorination and bromination of thiophane were examined. Addition of common acid or triethylamine leads to an in-

crease in the ratio of 2-halothiophane, but trifluoroacetic acid, p-toluenesulfonic acid, and boron trifluoride lead to an increase in the amount of 2,3-dihalothiophane. Competitive kinetic isotope effects of 5.1 and 3.6 were measured for chlorination and bromination, respectively. (auth)

10689 CHROMOCENE-BASED CATALYSTS FOR ETHYLENE POLYMERIZATION: KINETIC PARAMETERS. Karol, F. J. (Union Carbide Corp., Bound Brook, NJ); Brown, Gary L.; Davison, J. M. J. Polymer Sci., Polym. Chem. Ed.; 11: No. 2, 413-424(Feb 1973).

The chromocene catalyst for ethylene polymerization shows a high response to hydrogen which leads directly to highly saturated polyethylenes containing methyl groups as the major terminal functionality in the polymers. At a polymerization temperature of 90°C the ratio of termination rate constants for hydrogen (k_H) and ethylene (k_M) is $k_H/k_M = 3.60 \times 10^3$. The ratio of k_H to the chain propagation constant (k_P) is $k_H/k_P = 4.65 \times 10^{-1}$. A simple relation that can be derived from polymerization kinetics and the Quackenbos equation exists between melt index and hydrogen–ethylene ratio. A deuterium isotope effect (k_H/k_D) = 1.2 was calculated for the termination reaction. The overall polymerization process has an apparent activation energy of 10.1 kcal/mole. Oxygen addition studies show catalyst activity is proportional to initial divalent chromium content. (auth)

10690 SOLVENT EFFECTS ON THE KINETICS AND EQUILIBRIA ASSOCIATED WITH THE INTERCONVERSION OF 3-METHYLACETYLACETONE IN H_2O-D_2O MIXTURES. Dahlberg, D. B.; Long, F. A. (Cornell Univ., Ithaca, NY). J. Amer. Chem. Soc.; 95: No. 12, 3825-3831(13 Jun 1973).

The keto–enol and acid dissociation equilibrium constants for 3-methylacetylacetone were measured in pure H_2O and D_2O at 25.0°C. The rates of ionization of the keto form were determined by bromination in H_2O-D_2O mixtures for water and acetate catalysts. Fractionation factors ϕ and degenerate activity coefficients γ at 25.0°C were determined for the keto ($\phi = 1.0$, $\gamma = 1.04$), enol ($\gamma = 1.4$), and enolate ($\gamma = 2.0$) forms of the β-diketone. These data are analyzed in terms of Gross–Butler equations containing medium effects terms, thus allowing the determination of the degenerate activity coefficient and the fractionation factor ($\gamma^* = 1.5$ and $\phi^* = 0.35$) for transition states involved in the ionization of the ketone. Fractionation factors are important for a transferred proton in the transition state, i.e., for primary isotope effects, but do not influence equilibrium constants in H_2O and D_2O. Equilibrium constants are influenced predominantly by degenerate activity coefficients, particularly for anions where γ's deviate greatly from unity. Finally there seems to be no simple relationship between the degenerate activity coefficients of the reactants, products, and transition state of a simple proton transfer reaction. (auth)

10691 INFLUENCE OF THE THIRD COMPONENT ON THE RELATIVE VOLATILITY OF LIGHT AND HEAVY WATER. Tyminski, B.; Selecki, A. (Technical Univ., Warsaw). Nukleonika; 18: No. 2, 83-104(1973).

The influence of the third component additions on the relative volatility of light and heavy water was studied. LiCl, Li_2SO_4, NaCl, NaBr, Na_2CO_3, KCl, KBr, KI, $KBrO_3$, pyridine and 1,4-dioxane as a third component were used. For all these components measurements were made of vapor pressure in solutions with D_2O, for pyridine and 1,4-dioxane in solutions with H_2O and about 50% D_2O, and for Na_2CO_3 in solutions with about 50% D_2O at temperatures 25, 35, 45, 60, 75, and 90°C. Calculations of relative volatility were made using a method which has been treated in this work. The accuracy of calculations and mechanism of the action of the third component on the relative volatility in the system H_2O-D_2O–third component are discussed. (auth)

10692 MICROWAVE SPECTRUM, STRUCTURE, AND DIPOLE MOMENT OF N,N-DIMETHYLAMINODIBORANE. Cohen, E. A.; Beaudet, R. A. (California Inst. of Tech., Pasadena). Inorg. Chem.; 12: No. 7, 1570-1573(Jul 1973).

The microwave spectra of seven isotopic species of $(CH_3)_2NB_2H_5$ were assigned. Included are ^{11}B-, ^{10}B-, ^{15}N-labeled, and deuterated compounds. The molecular structure including the boron-bonded hydrogen coordinates was determined. Structural parameters other than those of the hydrogens are in close agreement with earlier electron diffraction results. No internal rotation splittings were detected. Also, the dipole moment was measured to be 2.77 ± 0.02 D. (auth)

10693 DEUTERIUM ISOTOPE EFFECTS IN THE PALLADIUM(II) AND THALLIUM(III) OXIDATION OF ETHYLENE. Henry, P. M. (Hercules Research Center, Wilmington, DE). J. Org. Chem.; 38: No. 13, 2415-2419(29 Jun 1973).

Previously reported conclusions concerning isotope effects on rate-determining steps in the oxidation of ethylene by Tl(III) and Pd(II) were tested. The kinetic isotope effect (k_H/k_D) for the oxidation of C_2H_4 by Tl(III) in aqueous $HClO_4$ was found to be 0.8. Actual deuterium isotope effects in the decomposition of intermediate hydroxymetalation adducts were found to be 1.92 for Tl(III) and 1.70 for Pd(III). These isotope effects, in conjunction with the kinetic isotope effects, support the earlier conclusion that hydroxymetalation is the rate-determining step in both oxidations. (JGB)

10694 INFRARED SPECTROPHOTOMETRIC INVESTIGATION OF STRUCTURE OF PARATUNGSTATE HYDRATES. Kiss, B. A. (Tungsram Research Inst., Budapest). Acta Chim. Acad. Sci. Hung.; 75: No. 4, 351-368(1973).

The ir spectra of paratungstate hydrates and of deuterated ammonium paratungstate·5-hydrate were investigated between 400 and 4000 cm^{-1}. It was found that the frequency, shape, and intensity relations of the bands in the region of the W—O vibrations are approximately identical, and the spectra of the microcrystalline salts are, to a very good approximation, independent of the point group symmetry of the crystal. The only difference found in the region of the stretching vibration of the terminal W—O groups is that the band exhibited in the spectra of the 28- and 11-hydrates at 940 cm^{-1} is split in the case of the 7-hydrate into 2, and in that of the 5-hydrate into 3 bands. This splitting is attributed to the differences between the bonds of type W—O(I), appearing with decreasing hydrate content. It was established that paratungstates contain in a smaller quantity also structural OH groups. Thermocondensation and spectral investigations indicate unequivocally that of the basic structures previously proposed as $([W_{12}O_{46}]^{20-})$ and $([W_{12}O_{42}]^{12-})$, the latter agrees with the experimental findings, so that the structure $[W_{12}O_{40}(OH)_2]^{10-}$ proposed for the paratungstate ion can be considered as of general validity. (auth)

10695 THERMODYNAMIC FUNCTIONS OF ISOTOPIC DIBORANE MOLECULES. Vizi, B. (Univ. of Chemical Industries, Veszprem, Hungary); Cyvin, S. J. Acta Chim. Acad. Sci. Hung.; 75: No. 4, 377-380(1973).

Thermodynamic functions of isotopic diborane molecules are calculated using spectroscopic data and assuming the rigid rotator harmonic oscillator approximation. The functions C^*_{mp}, S^*_m, $(H^*_m - E^*_{mO})/T$ and $-(G^*_m - E^*_{mO})/T$ are given for 100 to 1000°K. Diboranes containing ^{10}B, ^{11}B, H, and D are considered. (JGB)

10696 MICROWAVE SPECTRUM, STRUCTURE, AND ^{35}Cl NUCLEAR QUADRUPOLE COUPLING CONSTANT OF 4-CHLORONORTRICYCLENE. Laurie, V. W.; Stigliani, W. M. (Princeton Univ., NJ). J. Amer. Chem. Soc.; 95: No. 13, 4154-4157 (27 Jun 1973).

The microwave spectrum of four isotopic species (including ^{11}C, ^{12}C, ^{35}Cl, and ^{37}Cl) of 4-chloronortricyclene was studied. Moments of inertia obtained lead to the following substitution structural parameters: $r(C_1C_2) = 1.527 \pm 0.005$ Å, $r(C_1C_7) = 1.525 \pm 0.016$ Å, $\angle C_2C_1C_7 = 106.6 \pm 0.4°$. With assumption of the CCl bond length to be 1.763 Å, the following additional parameters are obtained: $r(C_7C_4) = 1.538 \pm 0.011$ Å, $\angle ClC_4C_7 = 115.7 \pm 1.0°$, $\angle C_7C_4C_3 = 102.6 \pm 0.5°$, $\angle C_1C_7C_4 = 96.2 \pm 0.7°$. The ^{35}Cl nuclear quadrupole coupling constant was found to be -69.2 ± 0.2 MHz. (auth)

10697 MECHANISM FOR SCRAMBLING AND DISSOCIATION OF SHORT LIVED INTERMEDIATE IN A CROSSED-BEAM REACTION OF METHYL CATION AND METHANE. Weiner, J.; Smith, G. P. K.; Saunders, M.; Cross, R. J. Jr. (Yale Univ., New Haven). J. Amer. Chem. Soc.; 95: No. 13, 4115-4120(27 Jun 1973).

Results are reported for crossed-beam studies of the ion–molecule reaction $CD_3^+ + CH_4 \rightarrow C_2X_5^+ + X_2$ (X = H,D) and its isotopic complement $CH_3^+ + CD_4 \rightarrow C_2X_5^+ + X_2$ (X = H,D). All $C_2X_5^+$ products arise from a direct reaction mechanism with no evidence of long-lived intermediate formation. Total reaction cross sections calculated from probability contour plots show a marked trend toward nonrandom H,D scrambling with increasing collision energy. A kinetic model of scrambling and dissociation in the short-lived intermediate is proposed to account for the results. (auth)

10698 TEMPERATURE DEPENDENCE OF CHLORINE KINETIC ISOTOPE EFFECTS FOR ALIPHATIC CHLORIDES. Turnquist, C. R.; Taylor, J. W.; Grimsrud, E. P.; Williams, R. C. (Univ. of Wisconsin, Madison). J. Amer. Chem. Soc.; 95: No. 13, 4133-4138(27 Jun 1973).

The temperature dependence of chlorine kinetic isotope effects (k_{35}/k_{37}) was established by experimental measurements in the range 0 to 60° for model Sn1 and Sn2 systems (tert-butyl chloride solvolysis and n-butyl chloride plus thiophenoxide anion reaction, respectively) in anhydrous methanol. The temperature dependence predicted by the Bigeleisen–Mayer heavy atom approximation

using measured ground state carbon–chlorine stretch frequencies and isotopic splitting is found to agree well with the experimental values for these two systems. The KIE dependence on temperature was found to vary linearly with 1/T over the limited range 0 to 60°. The magnitude of k_{35}/k_{37} is higher for the Sn1 reaction than for the Sn2 reaction at any given temperature (i.e., 1.0106 vs. 1.0089 ± 0.00015 at 20°) also as predicted by theory. (auth)

10699 AROMATIC HALOGENATION. IV. Kinetics and Mechanism of Iodination of Phenol and 2,6 Dibromophenol. Grovenstein, E. Jr.; Aprahamian, N. S.; Bryan, C. J.; Gnanapragasam, N. S.; Kilby, D. C.; McKelvey, J. M. Jr.; Sullivan, R. J. (Georgia Inst. of Tech., Atlanta). J. Amer. Chem. Soc.; 95: No. 13, 4261-4270(27 Jun 1973).

The kinetics of iodination of phenol were studied at 25.0° in dilute aqueous solutions of perchloric acid. From the observed dependence of rate upon the concentrations of phenol, iodine, iodide ion, and hydrogen ion, a mechanism is proposed wherein at very low iodide ion concentration molecular iodine makes a rate-determining attack upon phenoxide anion to give an intermediate iodocyclohexadienone; at high iodide ion concentration, this intermediate is formed in a reversible reaction and the rate-determining step shifts to deprotonation of the intermediate. This mechanism is confirmed by a similar study upon phenol-2,4,6-d_3. The isotope effect (k_H/k_D) increased from a value of 3.0 at an iodide ion concentration of 3×10^{-7} M, at which the iodination step is partially rate determining, to a limiting value of 6.2 at high iodide ion concentrations. In acetate buffers at high iodide ion concentration, acetate ion helps deprotonate the intermediate iodocyclohexadienone with an isotope effect which is about the same as that in dilute aqueous perchloric acid. In acetate buffer the isotope effect decreases with decreasing iodide ion concentration; however, the minimum value observed for the isotope effect was 3.4 at 3×10^{-7} M iodide ion rather than a smaller value that obtained in dilute aqueous perchloric acid solution. This unexpected result is explained on the basis of participation of acetyl hypoiodite as an iodinating agent at very low iodide ion concentration. The previously studied kinetics of iodination of adrenochrome may be explained by a mechanism similar to that proposed for phenol. Large isotope effects were observed in iodination and small isotope effects in bromination of 2,6-dibromophenol. (auth)

10700 SECONDARY DEUTERIUM ISOTOPE EFFECTS IN PERICYCLIC REACTIONS. Thermal Rearrangement of Dideuteriobiscyclopropylidene. Dolbier, W. R. Jr.; Alonso, J. H.. (Univ. of Florida, Gainesville). J. Amer. Chem. Soc.; 95: No. 13, 4421-4423(27 Jun 1973).

In an effort to promote further understanding of the mechanism of the cyclization of stabilized biradicals and to emphasize the effectiveness of secondary isotope effects as a tool in probing the nature of transition states in pericyclic reactions, the thermal rearrangement of dideuteriobiscyclopropylidene to deuterated methylenespiropentanes was investigated. (JGB)

Isotope Exchange and Isotope Separation

Refer also to abstract 10964.

10701 KINETICS OF HYDROGEN ISOTOPIC EXCHANGE OF THE HYDROXYL GROUP OF PHENOL DERIVATES IN SOLUTION. Bureiko, S. F.; Denisov, G. S.; Tupitsin, I. F. (Leningrad Univ.). Reakts. Sposobnost Org. Soedin., Tartu. Gos. Univ.; 9: No. 3, 773-783(Oct 1972). (In Russian).

The rate of the hydrogen isotopic exchange between the phenol derivates OH group and butylmercaptan SD group was measured in solution by means of ir spectroscopy. The process was found to be a bimolecular one. The rate constants of exchange are compared with the proton-donor and proton-acceptor powers of studied phenols (phenol, α-naphtol, β naphtol, p-cresol, p-chlorophenol and p-nitrophenol) in the formation of the hydrogen bonded complexes. The activation energies of hydrogen exchange processes were calculated. The data obtained are interpreted in terms of mechanism step of cooperative proton transfer in cyclic intermediate complex with hydrogen bonds. Results point to the weak protonation of the OH bond in the intermediate complex of the investigated reactions. The conclusion is drawn that the proton exchange rate is dependent on the strength of hydrogen bonds in the cyclic complex and determined by those characteristics of the molecular electron structure which control the ability of molecules to form hydrogen bonds as proton donors and proton acceptors. (auth)

10702 BASE-CATALYZED HYDROGEN EXCHANGE IN THE SERIES OF THE ACETYLENIC COMPOUNDS. Timokhina, L. V.; Nakhmanovich, A. S.; Borisova, A. I. (Irkutsk Inst. of Organic Chemistry, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, No. 2, Ser. Khim. Nauk; No. 4, 109-112(Mar 1973). (In Russian).

Rates of hydrogen isotopic exchange were measured for thirteen acetylenic compounds of various structure. The rate of deuterium exchange depends to a high degree upon stabilization of the carbanions in the transition state at the expense of the electron-withdrawing effects of the substituents. (auth)

10703 INTERACTION OF ELECTRON PAIRS AT PERI POSITIONS. Base-Catalyzed Hydrogen-Deuterium Exchange of Quinoline and 1,5-NAPHTHYRIDINE. Zoltewicz, J. A.; Sale, A. A. (Univ. of Florida, Gainesville). J. Amer. Chem. Soc.; 95: No. 12, 3928-3931(13 Jun 1973).

Rate constants for hydrogen-deuterium exchange of quinoline and 1,5-naphthyridine in $CH_3ONa-CH_3OD$ at 190.6° were obtained by an NMR method. Values for quinoline are 4.5×10^{-5} (H-2), 3.0×10^{-4} (H-3), 9.4×10^{-4} (H-4), and 4.5×10^{-5} (H-8) M^{-1} sec^{-1}. For 1,5-naphthyridine the values are 2.5×10^{-4} (H-2,6), 2.1×10^{-3} (H-3,7), and 9.2×10^{-3} (H-4,8) M^{-1} sec^{-1}. Isotope exchange is believed to take place by deprotonation of the substrates. H-3 and H-8 of quinoline have similar reactivities, and the H-4 to H-3 rate constant ratios are nearly the same for both compounds. Therefore, it is concluded that the effect of electron pair interactions on the rate of formation of a carbanion at a position peri to an annular nitrogen atom is not significantly different from the effect on a carbanion at a position meta to an annular nitrogen atom. (auth)

10704 SYNTHESIS OF N-(ALKYLAMINO)SUCCINAMIC ACID AND ITS ESTERS LABELED WITH ^{14}C AND T. Pacakova, J.; Soukupova, V.; Benes, J. (Institutes for Biological Research, Prague). Radiochem. Radioanal. Lett.; 14: No. 1, 35-42(25 May 1973).

Substituted derivatives of maleic and succinic acid belong to the plant retardants. A simple method has been described for the synthesis of ^{14}C and tritium labeled N-(alkylamino) succinamic acid and its esters. (auth)

10705 ISOTOPE EXCHANGE IN THE SYSTEM $O_2-\chi-Al_2O_3$. Trokhimets, A. I.; Evseenkov, Yu. D.; Beschetvertnaya, T. I.; Markevich, S. V. (Inst. of Physical-Organic Chemistry, Minsk). Dokl. Akad. Nauk BSSR; 16: No. 10, 905-908(Oct 1972). (In Russian).

The reactions of homo- (−70 to 570°C) and heteroexchange (400 to 550°C) were studied in the system $O_2-\chi-Al_2O_3$. At reaction temperatures >450°C the homoexchange process ($^{16}O_2 + {}^{18}O_2 \rightleftharpoons 2\ {}^{16}O^{18}O$) takes place both with and without participation of the oxygen on the Al_2O_3; at much lower temperatures the oxide surface plays no part. As a result a complex dependence of reaction rate on temperature was observed. Five mechanisms are proposed and discussed for the isotope exchange process in the $O_2-\chi Al_2O_3$ system. (KSW)

10706 GROUND STATE HYDROGEN–DEUTERIUM EXCHANGE OF NAPHTHALENE IN SULFURIC ACID SOLUTIONS. Stevens, C. G.; Strickler, S. J. (Univ. of Colorado, Boulder). J. Amer. Chem. Soc.; 95: No. 12, 3918-3922(13 Jun 1973).

Hydrogen–deuterium exchange reactions of α- and β-naphthalene-d_1 were studied in 50 to 67% H_2SO_4 solutions as a function of acid concentration and temperature. Exchange at the α position is faster than that at the β position by roughly a factor of 10. The logarithm of the pseudo-first-order rate constant is found to increase linearly with Hammett acidity; the slope for exchange at the β position exceeds that for exchange at the α position at all temperatures studied. Activation enthalpies and entropies are reported as a function of acid concentration. The activation enthalpy for reaction at the β position is 3 to 4 kcal/mol greater than for reaction at the α position, but the activation entropy is 4 to 5 cal/(deg mol) less negative. A modified hydration treatment is presented, and the results of this work are used to examine the extent to which hydration contributes to "excess reaction rates" in this system. The difference in activation entropy is interpreted as being due largely to differences in hydration of the respective transition states. The observation of entropy differences for two such closely related reactions indicates that caution must be used in correlating calculated reactivities with free energies of activation in such systems. (auth)

10707 SYNTHESIS OF ALKYPHOSPHORANES. Turnblom, E. W.; Katz, T. J. (Columbia Univ., New York). J. Amer. Chem. Soc.; 95: No. 13, 4292-4311(27 Jun 1973).

The synthesis is described of the first stable pentaalkylphosphorane, and some of the phenyl-substituted analogs. These phosphoranes are stable because strain in the precursory tetravalent phosphonium salt is relieved when a fifth substituent attaches to phosphorus. An alternative explanation, that the methyl protons in dimethylphosphoniahomocubane iodide (A) for example, are less acidic than those in tetramethylphosphonium iodide, is excluded by the observation that in 0.27 N NaOD at 26.8° the methyl protons in

A exchange with deuterons 44 times faster than those in tetramethylphosphonium iodide. The latter explanation also does not account for the reactions of phosphine oxides with phenyllithium and HBr giving a diphenylphosphonium salt and with methyllithium giving A, while the former explanation does. Alkylphosphoranes in general should be preparable if two of the substituents are constrained in a ring that is sufficiently small. Whether a cyclic phosphonium salt reacts with an organolithium reagent to give an ylide or a pentasubstituted phosphorane should depend on the ring angle at the phosphorus, and, if so, the angle below which pentasubstituted phosphoranes form and above which ylides form is bracketed between that in the bicyclo[4.2.1]nonane and the bicyclo[2.2.1]heptane ring systems. Bridgehead phosphorus ylides were also prepared. (auth)

10708 ACIDITY OF HYDROCARBONS. XLVIII. Kinetic Acidities of Mono-, Di-, and Triarylmethanes Toward Lithium Cyclohexylamide. Streitwieser, A. Jr.; Granger, M. R.; Mares, F.; Wolf, R. A. (Univ. of California, Berkeley). J. Amer. Chem. Soc.; 95: No. 13, 4257-4261(27 Jun 1973).

Tritium exchange rates with lithium cyclohexylamide in cyclohexylamine were determined for several aryl- and polyarylmethanes. Relative rates at 25° are p-biphenylyldiphenylmethane, 2.3, di-p-biphenylylmethane, 1.39, triphenylmethane, 1, diphenylmethane, 0.28, p-methylbiphenyl, 0.0048, m-methylbiphenyl, 0.0021, toluene, 0.00104. Comparison with known pK values for some of these hydrocarbons gives a linear Brønsted correlation with $\alpha = 0.314$ and permits extrapolation to a pK value for toluene of 40.9. These results indicate that delocalization effects are only partially developed at the transition state and that the central carbon is still highly pyramidal at the transition state. (auth)

10709 ACIDITY OF HYDROCARBONS. XLVII. Primary Kinetic Isotope Effects and Internal Return in Hydrogen Isotope Exchange Toluene and Triphenylmethane with Lithium Cyclohexylamide. Streitwieser, A. Jr.; Owens, P. H.; Sonnichsen, G.; Smith, W. K.; Ziegler, G. R.; Niemeyer, H. M.; Kruger, T. L. (Univ. of California, Berkeley). J. Amer. Chem. Soc.; 95: No. 13, 4254-4257(27 Jun 1973).

Experimental primary isotope effects for LiCHA-catalyzed proton exchange are compared for toluene and triphenylmethane. For toluene at 25°, $k^D_{exptl}/k^T_{exptl} = 2.82$ in cyclohexylamine (CHA) and $k^H_{exptl}/k^T_{exptl} = 27.2$ in cyclohexylamine-N,N-d_2 (CHA-d_2). For triphenylmethane at 25°, $k^H_{exptl}/k^T_{exptl} = 2.79$ in CHA and $k^H_{exptl}/k^T_{exptl} = 19.2$ in CHA-d_2. Derived internal return values show that internal return is greater for triphenylmethane than for toluene. Mechanistic primary isotope effects for the proton transfer step are also derived. The resulting k_t^H/k_t^D value is about 11 for both hydrocarbons. (auth)

Feed Materials Processing

Refer also to abstract 11124.

Radiation Chemistry

Refer also to abstracts 10746 and 12076.

10710 (COO-2147-8) PREPARATION AND CHARACTERIZATION OF BIOCOMPATIBLE POLYMERS BY RADIATION GRAFTING AND RADIOISOTOPE TECHNIQUE. Technical Progress Report, July 15, 1972–July 14, 1973. Andrade, J. D. (Utah Univ., Salt Lake City. Coll. of Engineering). May 1973. Contract AT(11-1)-2147. 28p. (UTEC-MSE-73-93). Dep. NTIS $3.50.

Research progress is reported on preparation and characterization of biocompatible polymers by radiation grafting including determination of grafting parameters for the preparation of hydroxyalkyl methacrylate surface grafts onto polypropylene and poly(dimethyl siloxane) substrates and a study of the role of water structuring in interfacial properties of hydrogels. (DHM)

10711 (JPRS-58764, pp 14-35) STUDY OF THE POSSIBILITY OF USING BITUMINIZATION FOR PROCESSING HIGHLY ACTIVE WASTES. Zakharova, K. P.; Kulichenko, V. V.; Martynov, Yu. P.; Sobolev, I. A.; Khomchik, L. M. 1972. Translation of SM-163/30.

A study is reported on the possibility of using bituminization for highly radioactive wastes in which the limiting value of the specific activity is based on the radiation-chemical stability of the bitumen blocks and the possible extraction of the heat accumulated in the blocks due to the energy of radioactive decay. It was concluded that in the use of bitumen of type BN-III for solidification of wastes with an activity of the order of 10 curies per liter, containing sodium nitrate, the storage of the final products does not cause any apprehensions from the standpoint of gas liberation and does not require the organization of forced heat removal. The storage of products with an activity up to 100 curies per liter is possible only upon condition of air cooling in the burial pits and prevention of the accumulation of products of radiolysis, in view of the possible increase in the concentration of hydrogen in the gaseous phase. (DHM)

10712 PULSE RADIOLYTIC POLAROGRAPHY: THE KINETICS OF THE OXIDATION OF THE ETHANOL RADICAL AT THE MERCURY ELECTRODE. Graetzel, M.; Bansal, K. M.; Henglein, A. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Ber. Bunsenges. Phys. Chem.; 77: No. 1, 11-16(1973).

The ethanol radical was produced in N_2O saturated, 2×10^{-3} molar aqueous ethanol solutions by a 20 ns pulse of high energy electrons. The anodic current of the radical was recorded as a function of time at various potentials of the mercury electrode and at various pH-values of the solution. The concentration of the radical in the bulk of solution as a function of time was simultaneously recorded by optical measurements. Analysis of the data shows that the electrode process is reversible in the 10^{-5} s range at pH > 12, i.e., when the base form of the radical is mainly present. Transfer rate constants of more than 1.0 cm s^{-1} are calculated. Below pH = 12, the electrode process becomes more irreversible with decreasing pH. The kinetics of the oxidation of the acid form of the radical is strongly influenced by its adsorption at the mercury electrode. The influence of electrochemically inactive adsorbed solutes is also investigated: adsorbed sulfate ions strongly decrease the anodic current at potentials more positive than −0.5 V. Fluoride ions exert a less pronounced effect. Adsorbed alcohol molecules have a promoting effect on the oxidation of the ethanol radical. (GE)

10713 INTERMEDIATES IN THE PULSE RADIOLYSIS OF SOLUTIONS OF PHENOTHIAZINE AND ITS DERIVATIVES. Reactions of Cycloalkylperoxyl Radicals with Phenothiazines. Burrows, H. D.; Kemp, T. J.; Welbourn, M. J. (Warwick Univ., Coventry, Eng.). J. Chem. Soc., Perkin Trans., II; No. 7, 969-974(1973).

Aerated cycloalkane solutions of phenothiazine (PTH) undergo pulse radiolysis to yield a transient species (λ_{max} 590 nm) building up after the pulse with $k = 3.42 \times 10^6$ 1 mol^{-1} s^{-1} (for C_6H_{10}). A comparison of the spectrum with spectra of ^{3}PTH, $PTH^{\cdot+}$, and $PTH^{\cdot-}$ (or of its conjugate acid) prepared by unambiguous routes, and with literature spectra (where known) of these species, suggests that the transient is not any of these, but is more probably the neutral radical species $PT^{\cdot}$, formed by attack of cycloalkylperoxyl radicals upon the substrate. Further evidence for this is supplied by the presence of a primary deuterium kinetic isotope effect upon the rate of formation of the transient, and alternative preparations of the neutral radical are discussed. Pulse radiolysis of an aerated solution of N-methylphenothiazine (PTMe) in cyclohexane gives a different type of spectrum (λ_{max} ca. 520 nm) which is formed very rapidly even after 25 ns pulses and which is characterised by comparison with spectra of species generated by known routes as the radical cation $PTMe^{\cdot+}$, possibly formed by electron transfer between PTMe and $RO_2^{\cdot}$. N-Benzyl-3,7-dioctyl-phenothiazine (dioctyl-$PTCH_2Ph$) again reacts with $RO_2^{\cdot}$ on a ns time scale at mM solute concentrations: the species formed in this case has not been identified unambiguously, but may be dioctyl-$PT^{\cdot}$ formed by the loss of the benzyl group. (auth)

10714 RADIOLYTIC PROCESSES IN MIXTURES OF CYCLOBUTANE AND PERFLUOROCYCLOBUTANE IN THE GAS PHASE. Heckel, E. (Univ. of Carolina, Greenville); Hanrahan, R. J. Int. J. Radiat. Phys. Chem.; 5: No. 3, 281-291(May 1973).

The gas phase γ-radiolysis of mixtures of cyclobutane and perfluorocyclobutane was studied for systems containing 0 to 100% of the fluorocarbon. The decomposition of cyclobutane to hydrocarbon products is sensitized by the presence of the fluorocarbon, but the hydrogen yield is directly proportional to the fraction of the energy deposited in the cyclobutane. It is suggested that energy is transferred from excited perfluorocyclobutane to cyclobutane molecules, which subsequently decompose, ultimately forming hydrocarbon products including ethane, ethylene, propane, butenes, and others. It appears that unsaturates, formed in the radiolysis, scavenge free $H^{\cdot}$ atoms, leaving only the unscavengeable H_2 yield for detection. It is suggested that electron capture by perfluorocyclobutane, followed by a neutralization reaction with the parent positive ion, leads to efficient rupture of the C–F bond and production of HF, as in other fluorocarbon–hydrocarbon mixtures. However, the concomitant interference with the production of $H^{\cdot}$ atoms, seen in other systems, does not lead to a significant lowering of the H_2 yield, which arises largely from other sources in cyclobutane radiolysis. Twenty-eight products were identified in all, and yields over the entire mixture range were recorded for twenty-four of them. The majority of the products contain only carbon and hydrogen. Four

perfluorocarbon compounds were found, as well as three mixed species containing both fluorocarbon and hydrocarbon moieties. Such products are probably formed by combination of radicals from both parent compounds. (auth)

10715 γ-RADIOLYSIS OF CYCLOBUTANE IN THE GAS PHASE. Heckel, E. (Univ. of Carolina, Greenville); Henrahan, R. J. Int. J. Radiat. Phys. Chem.; 5: No. 3, 271-279(May 1973).

An investigation has been made of the gas-phase radiolysis of cyclobutane at 20 torr (2.7 kN m^{-2}), pure and with added scavengers. Several products not previously reported from the radiolysis of the pure compound were found including propane, methylcyclobutane, cyclobutene, ethylcyclobutane, diacetylene, and at least four unsaturated C_6, C_7 and C_8 products. It was observed that the addition of approximately 10% oxygen had little effect on the yields of ethane, ethylene, and propane, whereas the yields of the butenes, ethylcyclobutane, and diacetylene were decreased by about 50%. The yield of acetylene doubled under the same condition, and the yield of cyclobutene increased fourfold. All other hydrocarbon products were eliminated. The effects caused by the addition of 10% ethylene were similar to those with added oxygen, except that the yield of ethylcyclobutane markedly increased. These observations are interpreted in terms of reactions of both ions and neutral species. (auth)

10716 LET EFFECTS ON FREE RADICAL YIELDS AND SPATIAL DISTRIBUTION IN IRRADIATED METHANOL. Investigation by Means of E.S.R. and E.S.E. Methods. Raitsimring, A. M.; Tsvetkov, Y. D.; Moralev, V. M. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). Int. J. Radiat. Phys. Chem.; 5: No. 3, 249-269(May 1973). (In Russian).

The radiation yields and spatial distribution of radicals trapped in glassy methanol irradiated at 77°K by different types of radiation were studied as a function of LET in a wide LET range from 1 to 540 eV/Å. It is found that the total yield of radicals $G(CH_2OH + e_{tr})$ change from G = 6 (^{60}Co γ-radiolysis) to G = 0.15 (^{235}U fission fragments radiolysis), and local radical concentrations are in the range from 1.6×10^{18} cm^{-3} to 7×10^{18} cm^{-3}. On the assumption that CH_2OH radicals and trapped electrons are uniformly distributed within the tracks, the estimations of track radii were made. These radii change from 90 Å (T β-radiolysis) to 180 Å (^{235}U fission fragments radiolysis). The semiempirical calculations of G-values, local concentrations and track radii are based on track structure models and ionic mechanism of methanol radiolysis. Calculated data are in a reasonably good agreement with the experimental results. (auth)

10717 IONIC REACTIONS IN THE γ-RADIOLYSIS OF TETRAHYDROFURAN. Kroh, J.; Haniewicz, E.; Zuchowicz, I. (Technical Univ., Lodz, Poland). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 21: No. 2, 153-158(1973).

The yield of hydrogen produced during the γ-radiolysis of tetrahydrofuran equals 3.6. In the presence of 0.25 M tritiated water $G(H_2)$ increases to 4.9 and tritiated hydrogen is formed. For water concentration 0.05 to 0.025 M the radiation yield of HT does not fulfill the Hummel equation for inhomogeneous scavenging. Electron scavengers (CCl_4, N_2O) decrease $G(H_2)$ (to 2.6) and G(HT). In this case the above equation is well fulfilled. The reactivity coefficient a_{CCl_4} equals 15 M^{-1}. The presence of sulfuric acid increases $G(H_2)$ (to 6.1) and G(HT). Effects of electron scavengers (CCl_4, N_2O and H_2SO_4) allow one to calculate the total ion-pair yield $G(e^-) = 3.6$. A similar value was obtained by measuring $G(N_2)$ in the presence of N_2O. (auth)

10718 DEHYDRATION EFFECT TO RADIATION INDUCED POLYMERIZATION OF ACRYLONITRILE. Iiyama, S.; Abe, S.; Namba, K. (Tokyo Univ.). J. Polym. Sci., Polym. Lett. Ed.; 11: No. 2, 81-85(Feb 1973).

The bulk polymerization of acrylonitrile in a strictly dry system at -78.5°C was studied. The dose rate dependency, the temperature effect of the rate of polymerization, and the copolymerization of acrylonitrile with methyl methacrylate in a system dried rigorously by BaO(dry system) were investigated in comparison with an ordinary system dried by CaH_2 (wet system), in order to understand the polymerization mechanism. The results of polymerization behaviors supported an anionic mechanism, so it seems that an anionic polymerization occurs in an extremely dry system of acrylonitrile at -78.5°C. (DHM)

10719 FREE RADICALS FORMED BY THE ADDITION OF A HYDROGEN ATOM ONTO VINYLPYRIDINES AND THEIR POLYMERS. Chachaty, C. (CEN de Saclay, Gif-sur-Yvette, France); Lablanch-Combiner, A.; Ronfard-Haret, J. C.; Loucheux, C. Compt. Rend., Ser. C; 276: No. 7, 535-538(12 Feb 1973. (In French).

The addition of hydrogen to 2- and 4-vinylpyridines and their polymers (irradiated with γ radiation in a vitreous matrix) was studied using ESR. The hydrogen generally fixes on the nitrogen of the ring. The corresponding radicals were identified from the theoretical values for the spin densities calculated for the different possible structures. (FR)

10720 SCF-MO CALCULATIONS OF SPECTRA OF KETYL RADICALS AND RADICAL ANIONS OF URACIL AND CYTOSINE. Grimison, A.; Eberhardt, M. K. (Puerto Rico Nuclear Center, San Juan). J. Phys. Chem.; 77: No. 13, 1673-1675(21 Jun 1973).

SCF-MO calculations were used to calculate spectral transitions of a series of possible intermediates in the reaction of uracil and cytosine with e^-_{aq}. The calculations were carried out using a specially designed PPP type approximation, including configuration interaction. In some cases the calculations confirm previous spectral assignments, but in other cases new assignments were made. (auth)

10721 BIMODAL MOLECULAR WEIGHT DISTRIBUTION OF POLY(VINYL ACETATE) PRODUCED IN n-HEXANE BY RADIATION. Wada, T.; Machi, S. (Japan Atomic Research Inst., Takasaki). J. Polym. Sci., Polym. Lett. Ed.; 11: No. 2, 115-120(Feb 1973).

The molecular weight distributions of poly(vinyl acetate) produced by radiation polymerization in the presence of n-hexane, as precipitant for the polymer, are reported. As was expected, bimodal molecular weight distributions were observed for the polymers produced in the heterogeneous polymerizations. Since vinyl acetate is a good solvent for the polymer, the polymerization in the presence of an adequate amount of the precipitant is considered to proceed in two different phases, solution and solid phase. The coexistence of these two different phases leads to bimodal distributions. (auth)

10722 ELECTRON SPIN RESONANCE STUDY OF THE REACTION OF HYDROXYL RADICALS WITH PYRROLE, IMIDAZOLE, AND RELATED COMPOUNDS. Samuni, A.; Neta, P. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem.; 77: No. 13, 1629-1635(21 Jun 1973).

Radicals produced by the reaction of OH with pyrrole, 2-pyrrolecarboxylic acid, N-methylpyrrole, N-methyl-2-pyrrolecarboxylic acid, imidazole, 2-methylimidazole, 4,5-imidazoledicarboxylic acid, isoxazole, pyrazole, 3,5-pyrazoledicarboxylic acid, maleimide, and N-ethylmaleimide were studied by the in situ radiolysis steady-state ESR technique. In all cases OH has been found to add to a carbon rather than to abstract H. With pyrroles addition takes place at the position adjacent to the nitrogen and with imidazoles addition to both positions 2 and 5 has been found. In contrast to the furans the OH adducts do not undergo ring opening in alkaline solutions. In the case of pyrrole, imidazole, and 2-methylimidazole the OH adducts were found to undergo a base-catalyzed water elimination involving the OH and the H from NH. In the carboxy derivatives water elimination is a slow process and was not detected. In the latter radicals a small splitting by the OH proton was observed in neutral solution but disappeared at pH > 10 for imidazoles and >11 for pyrroles. The disappearance of the OH proton splitting is a result of rapid proton exchange. Furthermore, dissociation of the OH proton occurs with pK = 12 for the 4,5-imidazoledicarboxylate adduct and pK = 13.5 for the adducts of 2-pyrrolecarboxylate and N-methyl-2-pyrrolecarboxylate. Hydroxyl radicals add to isoxazole at the 5 position adjacent to the oxygen rather than that adjacent to the nitrogen. Addition to pyrazole also takes place at the 5 position, next to the NH group, and in both cases of isoxazole and pyrazole comparable allylic type radicals are observed. With 3,5-pyrazoledicarboxylic acid, however, OH adds to the 4 position probably because the 5 position is sterically hindered by the carboxyl group. (auth)

10723 KINETICS OF OH^- AND H^+ REACTIONS OF PYRIMIDINES AND PURINES BY PULSE RADIOLYSIS. Greenstock, C. L. (Atomic Energy of Canada, Ltd., Pinawa, Manitoba, Can.); Shragge, P. C.; Hunt, J. W. J. Phys. Chem.; 77: No. 13, 1624-1628(21 Jun 1973).

The kinetics of proton transfer to and from nucleic acid derivatives in aqueous solution was studied as a function of pH, dose per pulse, and solute concentration by pulse radiolysis. The method involves monitoring the narrow-band transient uv absorption produced by the differences in absorption spectra between ionized and neutral solute. The OH^- ions produced by the radiation pulse deprotonate the pyrimidine and purine molecules; the rates of this reaction are in the range 1 to 2×10^{10} M^{-1} sec^{-1}. At high doses per pulse and low solute concentrations the rate constant for the competing second-order charge neutralization between solvent ions is measured to be $(4.1 \pm 1.2) \times 10^{11}$ M^{-1} sec^{-1}, three times that measured by relaxation methods. The rate constants for protonation of the ionized nucleic acid derivatives are close to 5×10^{10} M^{-1} sec^{-1}. The complex kinetics of recombination have been simulated with a computer program using

the measured parameters; the calculated and observed kinetics agree well. (auth)

10724 LUMINESCENCE EMISSION AND EXCITATION SPECTRA OF BENZENE AND ALKANE THIN FILMS UNDER SLOW ELECTRON IMPACT AT 77°K. Hiraoka, K.; Hamill, W. H. (Univ. of Notre Dame, Indiana). J. Phys. Chem.; 77: No. 13, 1616-1620 (21 Jun 1973).

Luminescence bands of thin-film benzene at 77°K, excited by slow electron impact, are attributed to fluorescence of the monomer at 275 nm, of benzene excimer at 315 nm, of an unknown at 390 nm, and possibly to the phosphorescence of biphenyl at 430 to 530 nm. Alkane emissions appear at 250, 290, 340, and ~500 nm for neopentane; at 220, 325, and 480 nm for 3-methylpentane; at 200, 280, 365, and 510 nm for n-hexane; at 200, 280, 370, and 480 nm for cyclohexane; and at 200, 290, 375, and 510 nm for n-nonane. Luminescence excitation spectra by slow electron impact were measured. For alkanes the 200 to 250-nm fluorescence bands onset at ~8 eV, the 340 to 375-nm and the 480 to 530-nm bands have the same onset for each alkane at ~14 eV. The 280 to 290-nm bands were too weak for excitation measurements. The ~290-nm band could not be detected for 3-methylpentane, nor was the 430-nm recombination luminescence observed. (auth)

10725 ELECTRON SPIN RESONANCE STUDY OF OXYGEN SPECIES ADSORBED ON γ-IRRADIATED ZEOLITES. Vedrine, J. C.; Naccache, C. (CNRS, Villeurbanne, France). J. Phys. Chem.; 77: No. 13, 1606-1610 (21 Jun 1973).

Molecular oxygen instantaneously reacts at 77°K with V centers created by γ irradiation of hydrogen faujasite and mordenite type zeolites. The paramagnetic oxygen species were found to be unstable and the V centers to be restored by outgassing at room temperature. The ESR spectra are characterized by two signals with the following parameters: for HY zeolite, $g_{zz} \simeq 2.032$, $g_{yy} \simeq 2.0015$, and $g_{xx} = 1.9995$ and $g_{zz} \simeq 2.022$, $g_{yy} \simeq 2.0015$, and $g_{xx} = 1.9975$; for HZ zeolite, $g_{yy} \simeq 2.0005$ and $g_{xx} = 1.9985$ and $g_{yy} \simeq 2.0005$ and $g_{xx} \simeq 1.9965$. Using ^{17}O-enriched oxygen, only g_{yy} could be resolved into two components, $c^{A}_{yy} = 84.5$ and $c^{B}_{yy} = 64.2$ Oe, for both samples while the other components were shown to be small and unresolved. The oxygen species were identified with peroxy radicals weakly bonded to O atoms of the zeolite lattice. (auth)

10726 ESR STUDY ON RADICAL CONVERSIONS IN IRRADIATED LOW DENSITY POLYETHYLENE. Tsuji, K. (Sumitomo Chemical Co., Ltd., Takatsuki, Japan). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 2, 467-484(Feb 1973).

ESR studies were carried out on radical conversions by thermal and photochemical mechanisms in low-density polyethylene irradiated mainly with electron beams at −196°C both in vacuum and in the presence of CO. According to the spectral change, the following radical conversions were elucidated for the samples irradiated in vacuo [eqs. (1) and (1′)] and in the presence of CO [eqs. (2) and (2′)]: $-CH_2\dot{C}HCH_2- \xrightarrow{\text{room temperature}} -CH=CH-\dot{C}H- \xrightarrow[\text{UV-39}]{h\nu} -CH_2\dot{C}HCH_3$ (1); $-CH_2\dot{C}HCH_3 \rightarrow -CH_2\dot{C}HCH_2- \xrightarrow{0°C} -CH=CH-\dot{C}H- \xrightarrow[\text{no filter}]{h\nu} -CH_2\dot{C}HCH_3$ (1′); $-CH_2\dot{C}HCH_2- \xrightarrow[CO]{-78°C} -CH_2\underset{\dot{C}=O}{\underset{|}{C}}HCH_2- \xrightarrow[\text{temperature}]{\text{room}} -CH=CH-\dot{C}H- \xrightarrow[\text{UV-39}]{h\nu} -CH_2\dot{C}HCH_3$ (2); $-CH_2\dot{C}HCH_3(\rightarrow -CH_2\dot{C}HCH_2-) \xrightarrow[CO]{-78°C}$ acyl radicals $\xrightarrow{0°C} -CH=CH-\dot{C}H- \xrightarrow[\text{no filter}]{h\nu} -CH_2\dot{C}HCH_3$ (2′). From the resemblance of the ESR spectrum observed after direct photolysis of polyethylene to that observed after photoinduced radical conversion of the allylic radicals, it is concluded that an eight-line ESR spectrum observed immediately after photolysis of polyethylene at −196°C could be attributed more reasonably to the alkyl radicals $-CH_2\dot{C}HCH_3$ than to $-CH_2CH_2\cdot$ and $-CH_2\dot{C}HCH_2-$. (auth)

10727 GAS CHROMATOGRAPHIC CONDITIONS FOR THE ANALYSIS OF γ-IRRADIATED BENZONITRILE FOR CYANO-AROMATIC PRODUCTS. Knight, J. A. (Georgia Inst. of Tech., Atlanta). J. Chromatogr.; 79: 325-328(16 May 1973).

The gas chromatographic conditions are described for the analysis of products from the γ radiolysis of benzonitrile, specifically dicyanobenzenes, cyanobiphenyls, and dicyanobiphenyls. (DHM)

10728 RADIOTHERMOLUMINESCENCE OF CRYSTALLINE AND VITREOUS METHANOL. III. Quenching of the Radiothermoluminescence of Methanol with Carbon Tetrachloride and Photobleaching. Roszak, W.; Kroh, J. (Interdepartmental Inst. of Radiation Techniques, Lodz, Poland). Nukleonika; 18: No. 4, 165-172(1973).

A study was made on the influence of the addition of carbon tetrachloride and bleaching with visible and monochromatic light on the radiothermoluminescence (RTL) of methanol. All of the aforementioned agents caused a reduction in the intensity of the RTL. The RTL was quenched most effectively by light quanta with an energy absorbed to the maximum extent by a stabilized electron in the vitreous methanol. It has been proved that the process of recombination of an electron freed from a trap and a methanol-solvated proton is the source of RTL. (auth)

10729 RADIOLYSIS OF TBP−DILUENT−HNO_3 SYSTEMS. II. The Effect of Nitric Acid Concentrations on Zirconium Numbers. Nowak, Z. (Inst. of Nuclear Research, Warsaw); Krejzler, R.; Nowak, M.; Rochon, A. Nukleonika; 18: No. 2, 63-69 (1973).

The effect of nitric acid concentration on Z-numbers of γ-irradiated TBP−diluent−HNO_3 systems was studied. The highest Z-numbers were found for solutions of TBP irradiated with 0.5M nitric acid. Radiolysis products formed at low concentrations of nitric acid are difficult to remove by sodium hydroxide solution. It was found that the values of Z-numbers are in good agreement with the values of absorbance at 430 nm. (auth)

10730 RADIOLYSIS OF SOME HNO_3 COMPLEXES. Kozlowska Milner, E. (Inst. of Nuclear Research, Warsaw). Nukleonika; 18: No. 3, 121-131(1973).

Effects of the hydrogen bond on the course of γ radiolysis of some HNO_3 complexes were studied. ESR spectra (at 77°K) of the systems HNO_3−1,4-dioxane, HNO_3-CHCl_3, HNO_3-KNO_3 were measured. The results obtained would imply that screening the OH group of the acid by a hydrogen bond results in inhibition of the reaction, $OH + HO-NO_2 \rightarrow H_2O + NO_3$ (2). In the system HNO_3−dioxane the inhibition of reaction (2) favors process (3) $RH + OH \rightarrow R' + H_2O$, competing with the above mentioned reaction. This results in a lack of a signal of the NO_3 radical in ESR spectra of irradiated HNO_3−dioxane complexes (the range of acid concentration in the mixture $x_{HNO_3} = 0$ to 0.67). On the basis of the measurements of changes in the total radical yield it is postulated that the radiolysis of the HNO_3−dioxane complexes proceeds according to reaction (6), $C_4H_8O_2 \cdot HO-NO_2 \rightarrow C_4H_7O_2^{\cdot} + NO_2 + H_2O$. An interpretation of the $HNO_3-N_2O_4$ system, studied previously is offered. The radiolysis of HNO_3-KNO_3 complexes results in the formation of a non-axially symmetric NO_3 radical, hydrogen-bonded with HNO_3. (auth)

10731 MOLECULAR EVOLUTION. Prebiological and Biological. Volume Commemorating the Sixtieth Birthday of Sidney W. Fox. Rohlfing, D. L.; Oparin, A. I. (ed.). New York; Plenum Publishing Corporation (1972). 497p. $24.00.

Thirty-five papers on the origin of life are included. One paper has been abstracted separately for NSA. (JGB)

For an abstract of an individual paper see: 10732.

10732 INVESTIGATION OF THE POSSIBLE DIFFERENTIAL RADIOLYSIS OF AMINO ACID OPTICAL ISOMERS BY ^{14}C BETAS. Bernstein, W. J.; Lemmon, R. M.; Calvin, M. (Univ. of California, Berkeley). pp 151-155 of Molecular Evolution. Rohlfing, D. L. (ed.). New York; Plenum Publishing Corp. (1972).

Differences in the radiation susceptibility of amino acids were studied by an investigation of crystalline, ^{14}C-labeled, DL-amino acids, which had been stored from 12 to 24 years and therefore subjected to self-radiolysis. The analyses for possible differential radiolysis of the optical isomers were carried out by a search for measurable optical activity in each sample. No rotations were found; failure to detect any differential radiolysis is rationalized. (JGB)

10733 CHAIN REACTIONS CAUSED BY GAMMA RADIATION DEHALOGENATION OF 1,1,1,2-TETRACHLOROETHANE AND 1,1,2-TRICHLORO-1-BROMOETHANE IN CYCLOHEXANE. Alony, R. Jerusalem; Hebrew University (1972). 68p. (In Hebrew).

Thesis.

The dehalogenation of 1,1,1,2-tetrachloroethane and 1,1,2-trichloro-1-bromoethane in cyclohexane solution caused by γ radiation were studied and their reaction mechanism proposed. The relative Arrhenius parameters were measured for the reactions: $c-C_6H_{11} + 1,1,1,2-C_2Cl_4H_2 \rightarrow c-C_6H_{11}Cl + C_2Cl_3H_2$; $c-C_6H_{11} + 1,1,1,2-C_2Cl_4H_2 \rightarrow c-C_6H_{12} + C_2Cl_4H$; $C_2Cl_3H_2 + c-C_6H_{12} \rightarrow 1,1,2-C_2Cl_3H_3 + c-C_6H_{11}$; $C_2Cl_3H_2 \rightarrow 1,1-C_2Cl_2H_2 + Cl$; $c-C_6H_{11} + C_2Cl_3BrH_2 \rightarrow c-C_6H_{11}Br + C_2Cl_3H_2$; $c-C_6H_{11} + C_2Cl_3BrH_2 \rightarrow c-C_6H_{11}Cl + C_2Cl_2BrH_2$. The corresponding values obtained were: $E_3 - E_2 = 0.47 \pm 0.48$ kcal mole^{-1}; $A_2/A_3 = 10^{1.37 \pm 0.36}$; $E_5 - E_4 = 9.47 \pm 0.18$ kcal mole^{-1}; $A_5/A_4 = 10^{5.49 \pm 0.09}$ mole lt^{-1}; $E_5 - E_4 = 9.60 \pm 0.47$ kcal mole^{-1}; $A_5/A_4 = 10^{5.59 \pm 0.24}$ mole lt^{-1}; $E_{36} - E_{35} = 5.33 \pm 1.36$ kcal mole^{-1}; $A_{36}/A_{35} = 10^{0.64 \pm 0.65}$. (INIS)

10734 ION–MOLECULE REACTIONS IN MIXTURES OF METHANE WITH WATER, HYDROGEN SULFIDE, AND AMMONIA. Huntress, W. T. Jr.; Pinizzotto, R. F. Jr.; Laudenslager, J. B. (California Inst. of Tech., Pasadena). J. Amer. Chem. Soc.; 95: No. 13, 4107-5115(27 Jun 1973).

Ion–molecule reactions of ions formed by electron impact in mixtures of methane with water, hydrogen sulfide, and ammonia were studied using ion–cyclotron resonance techniques. The reactions of primary ions were identified and their relative reaction rates measured using the resonant cyclotron ejection method. Absolute rates were determined by reference to the absolute rates previously measured for the major reactions occurring in the pure gases. (auth)

10735 EFFECT OF THE DIELECTRIC CONSTANT ON THE REACTIVITY OF THE SOLVATED ELECTRON. Barat, F.; Gilles, L.; Hickel, B.; Lesigne, B. (CEN de Saclay, Gif-sur-Yvette). J. Phys. Chem.; 77: No. 13, 1711-1715(21 Jun 1973).

The effect of the dielectric constant of the solvent on the reactivity of the solvated electron formed by pulse radiolysis was studied in water–ethanol mixtures. It was found that the rate constant $k(e_s^- + NO_3^-)$ diminishes with decreasing water concentration whereas $k(e_s^- + Zn^{2+})$ increases in going from pure water to 60% by weight ethanol. On the other hand, $k(e_s^- + H^+)$ is almost invariant with the solvent composition, from pure water to 99% by weight ethanol. From measurements of the rate constant of the very fast reaction $e_s^- + C_6H_5NO_2$ we have estimated the diffusion coefficient of the solvated electron in water–ethanol mixtures. Using the appropriate equations with the values of the diffusion coefficient of e_s^- thus determined it was shown that it is possible to correlate the rate constants of the reactions between solvated electrons and ions with the macroscopic dielectric constant of the medium. The distance at which reaction takes place is, in each case, approximately equal to the sum of the individual ionic radii. (auth)

10736 EFFECT OF NUCLEAR REACTOR IONIZING RADIATION ON IRON ACETYLACETONATE. Sokol'skii, D. V.; Khlystov, A. S.; Dautov, L. M.; Nadykto, B. T. (Inst. of Organic Catalysis and Electrochemistry, Alma Ata, USSR). Dokl. Akad. Nauk SSSR; 208: No. 6, 1401-1403(21 Feb 1973). (In Russian).

Samples of iron acetylacetonate ($Fe(C_5H_7O_2)_3$) were recrystallized and subjected to the radiation in the vertical hole of the VVR-K reactor at integral flux levels of 10^{17} to 10^{19} neutrons/cm^2, and then studied by the methods of gamma resonance spectroscopy. Beginning with an integral flux of 10^{17}, the spectrum contained quadrupole splitting $\Delta = 0.60$ mm/sec. Supplementary lines were observed after increasing the neutron dose to 10^{18}, which were associated with the presence of Fe(II) ions ($\sigma_1 = 0.65$, $\sigma_2 = 1.57$ mm/sec, $\Delta_1 = 0.64$, $\Delta_2 = 2.34$ mm/sec). (KSW)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 11142.

10737 TRANSACTIONS OF THE SPWLA FOURTEENTH ANNUAL LOGGING SYMPOSIUM. Conference Held at Lafayette, Louisiana, May 6–9, 1973. Houston, TX; Society of Professional Well Log Analysts, Inc. (1973). 316p. (CONF-730521–). $12.00.

From 14th annual logging symposium; Lafayette, Louisiana, USA (6 May 1973).

Separate abstracts were prepared for eight of the twenty-eight papers presented. (DHM)

For abstracts of individual papers see: 10738, 10747, and 10886–10891.

10738 EFFECTIVE POROSITY AND SHALE VOLUME DETERMINATION FROM NEUTRON LIFETIME AND SIDEWALL NEUTRON LOGS. Alguero, A. J. (Dresser Atlas, Comodoro Rivadavia, Argentina); Watt, H. B.; Wichmann, P. A. pp X1-X19 of Transactions of the SPWLA Fourteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1973).

From 14th annual logging symposium; Lafayette, Louisiana, USA (6 May 1973). See CONF-730521–.

Combinations of logs are frequently used to solve for effective porosity and one or more lithologic components. Densilog, Acoustilog, and Epithermal Neutron logs are most commonly used for these purposes. The theory of these solutions and their attendant conventional cross plots are described, and a technique that uses the Neutron Lifetime Log (service mark of Dresser Atlas, Petroleum Services Division of Dresser Industries, Inc.) as a porosity log is presented. In combination with the Sidewall Epithermal Neutron Log (SWN), a good solution for porosity and shale percentage is obtained. Favorable conditions for the application of this technique are the presence of low formation water salinities or deep invasion with fresh mud filtrate. Two examples of the technique are included. The first is in a carbonate sequence containing moderate water salinities, the other is a tuffaceous sand-shale series with very low formation water salinities. Comparison with conventional interpretation technique is included. Results using this method are considered good, especially when compared with the analyses from correlative conventional cross plots. The technique represents a new approach with good prospects for using the Neutron Lifetime Log as a porosity log in combination with other porosity tools. It also adds a new dimension to the already demonstrated versatility of the NLL. (auth)

Hot-Atom Chemistry

10739 (LBL-1687) RECOIL TRITIUM REACTIONS WITH CYCLOHEXENE AND METHYLCYCLOHEXENE. Fee, D. C. (California Univ., Berkeley. Lawrence Berkeley Lab.). Jun 1973. Contract W-7405-eng-48. 189p. Dep. NTIS $11.50.

Thesis.

A study was made of the reactions of recoil tritium atoms with cyclohexene (at 25°C and 135°C) and with methylcyclohexene (at 135°C). Principal attention was given to unimolecular decomposition processes following T-for-H substitution. T was produced by recoil in the $^3He(n,p)T$ reaction. The tritiated products were analyzed with a specially designed radio-gas-chromatographic system. The comparative efficiency of SO_2 and O_2 as radical scavengers was determined in the T + cyclohexene, T + trans-2-butene, and T + n-butane gas phase system at 25°C. The anomalous increase in the butadiene-t yield (from T + cyclohexene reactions at 25°C) with O_2 scavenging was clarified by determining the comparative efficiency of H_2S, butadiene-d_6, O_2, and SO_2 as radical scavengers in the T + cyclohexene system at 25°C. All products except butadiene-t exhibit normal behavior with O_2, SO_2, or H_2S scavenging. The pressure dependence (in the 300 to 1500 torr pressure range) of the products of recoil tritium reactions with cyclohexene was determined at 135°C. The dependence of product yield on pressure showed that ethylene-t and butadiene-t resulted from the unimolecular decomposition of excited cyclohexene-t (formed by T-for-H substitution). The apparent rate constant of cyclohexene-t unimolecular decomposition was determined as 5.1×10^6 sec^{-1}. The s parameter in the RRK (for Rice, Ramsperger and Kassel) treatment of the unimolecular decomposition of cyclohexene was determined as s = 24. Similarly, the pressure dependence of product yield showed that n-hexene-t, 1-butene-t and methane-t resulted from the unimolecular decomposition of cyclohexyl-t radical (formed by T addition to cyclohexene) with rate constants of 8×10^3 sec^{-1}, 3×10^4 sec^{-1}, and 5×10^2 sec^{-1}, respectively. The relative rate of abstraction versus addition of radicals in alkenes was determined from the scavenger dependence of the yields of products with a radical precursor. In studies on the reactions of recoil tritium atoms with methylcyclohexene, the dependence of product yield on pressure (300 to 1200 torr pressure range) showed that excited 4-methylcyclohexene-t (formed by T-for-H substitution) decomposed unimolecularly to give propylene-t or butadiene-t with a rate constant of 1×10^7 sec^{-1} and that similarly excited 3-methylcyclohexene-t decomposed unimolecularly to give ethylene-t or pentadiene-t with a rate constant of 3×10^6 sec^{-1}. A test was made of the RRK-RRKM assumption (M reflects the contribution of Marcus) of energy randomization prior to unimolecular decomposition. The rates of unimolecular decomposition of cyclohexene-1-t and cyclohexene-3-t (formed by T-for-methyl substitution reactions of recoil tritium atoms with 1-methylcyclohexene and 3-methylcyclohexene, respectively) were compared. It was concluded that the RRK-RRKM assumption of energy randomization prior to unimolecular decomposition is valid for the recoil tritium initiated unimolecular decomposition of cyclohexene. (JGB)

10740 INFLUENCE OF PROTON RADIATION ON RECOIL ATOMS AND THE APPLICATION OF KCl SINGLE CRYSTALS. Bogdanov, R. V.; Olevskii, E. B. Vestn. Leningrad. Univ., No. 22, Fiz., Khim.; No. 4, 150-152(Nov 1972). (In Russian).

The state of ^{32}P recoil atoms in potassium chloride monocrystals irradiated with protons inhomogeneously was analysed from the kinetic point of view. No simple correlation was found between the yield of ^{32}P oxidized forms and the amount of proton absorption. (auth)

Properties of Radioactive Materials

Refer also to abstracts 10629–10631, 11109, 11114, 11115, 11117, 11118, and 12076.

10741 (CEA-CONF-2171) LIQUID-VAPOR EQUILIBRIUM OF SEVERAL VOLATILE FLUORIDES IN MIXTURES WITH UF_6 OR ClF_3. Carles, M. M. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [nd]. 8p. (In French). (CONF-720987-1). Dep. NTIS (U. S. Sales Only) $3.00.

From third European conference on the chemistry of fluorine; Aix-en-Provence, France (14 Sep 1972).

The liquid-vapor equilibria of the volatile fluorides MoF_6, WF_6, VF_5, and $C_2Cl_2F_4$ mixed with UF_6 and ClF_3 at a constant pressure of 2600 torr were studied. A metallic apparatus capable of resisting corrosion from liquid fluorinated compounds was developed. The apparatus enabled curves to be plotted for the vapor pressure of pure substances and the equilibria of various binary mixtures. Out of the 4 binary mixtures obtained with UF_6, only the UF_6-VF_5 system presents an azeotrope. The concentration-temperature graphs represent the dew and boiling curves together with the temperature of the UF_6-VF_5 azeotrope. The activity coefficients of the constituents in solution in the liquid yield the difference between the solutions obtained and ideal solutions (Raoult law). In the case of the 4 mixtures obtained with ClF_3, the equilibrium curves demonstrate that all the systems present azeotropes. The ClF_3-MoF_6, ClF_3-WF_6, and ClF_3-$C_2Cl_2F_4$ mixtures give minimum boiling point azeotropes. The temperatures of these azeotropes can be obtained from the dew and boiling curves. A purification procedure for UF_6 was developed which utilizes ClF_3 loaded distillation columns. In this way, it is possible to easily separate MoF_6 and WF_6 from UF_6 (minimum boiling point azeotrope between ClF_3 and MoF_6 or WF_6). (FR)

10742 (COO-3105-5) PROGRESS REPORT, AUGUST 1972-MAY 1973. (Columbia Univ., New York). 1973. Contract AT(11-1)-3105. 22p. Dep. NTIS $3.25.

Progress is reported in the following areas: 1) The development of methods designed to determine simultaneously the tritium distribution in purified peptides and the radiochemical purity of the component amino acids. 2) Chemical characterization of tritium labeled oligo-peptides. 3) Documentation of the tritium distribution in adrenocorticotropin (ACTH), gonadotropin-releasing hormone (GnRH) and several other oligopeptides. 4) The temperature at the site of the reaction during tritium atom bombardment and measurement of the comparative surface areas of labeled substrates. 5) Studies of the extent of reduction of aliphatic double bonds and aromatic rings under the specific conditions of our tritium reaction and in contrast to that occurring with Wilzbach labeling conditions. 6) Further refinement of the ACTH bioassay and the demonstration of parallel bioassay response with two ^3H-labeled ACTH preparations. 7) Development of methods studying the specific binding of ^3H-peptides and proteins. 8) Studies of the metabolism of ^3H-ACTH and preliminary observation of metabolites of ^3H-GnRH. (auth)

10743 OBSERVATIONS ON THE ISOTHERMAL DEHYDRATION OF URANYL(VI) NITRATE HEXAHYDRATE ABOVE ROOM TEMPERATURE. Moseley, P. T.; Seabrook, C. J. J. Chem. Soc., Dalton Trans.; No. 10, 1115-1120(1973).

The dehydration of uranyl(VI) nitrate hexahydrate to the trihydrate was studied gravimetrically between 313 and 343°K at varying water-vapour pressures in flowing air. With crushed crystals the dehydration rate is controlled by diffusion of water through the powder bed, even when using very shallow bed depths; with single crystals the kinetics of dehydration conform to a contracting-interface model. The activation energy is higher than that reported for vacuum decomposition. X-ray powder data for the hexa- and trihydrates of uranyl(VI) nitrate were also recorded. Single crystals of the former grew with a similar habit to that found by earlier workers, but with a different orientation of the crystal axes. When partially dehydrated crystals were heated above the melting point of the hexahydrate (333°K), it was observed that the molten hexahydrate was encapsulated in a sheath of solid polycrystalline trihydrate. Under these conditions, the dehydration reaction became very slow but accelerated again on cooling below the hexahydrate melting point. (auth)

10744 DIAGRAM OF POTENTIAL VS. pO^{2-} OF URANIUM IN THE MOLTEN LiCl-KCl EUTECTIC. Landresse, G.; Duyckaerts, G. (Univ., Liege). Anal. Chim. Acta; 65: No. 1, 245-247(Jun 1973). (In French).

The potential/pO^{2-} diagram of U in the LiCl-KCl eutectic at 450°C was determined for a solution such that $[U^{3+}] = [U^{4+}] = [UO_2^+] = [UO_2^{2+}] = 10^{-2}$ M. If UO_2 is to be prepared by cathodic reduction of a uranyl bath in LiCl-KCl, it can be established from the diagram that from a UO_2^{2+} bath with high pO^{2-} that the reduction to U^{4+} liberates oxide ions which reduce progressively the pO^{2-} and this U^{4+} rapidly disappears by amphoterization and is transformed into UO_2^{2+}. When pO^{2-} becomes sufficiently low, the reduction occurs directly according to $UO_2^{2+} \rightarrow UO_2^+ \rightarrow UO_2\downarrow$. (JSR)

10745 FREQUENCIES OF MO_2^{2+} GROUP VALENCE OSCILLATIONS IN COMPLEXES OF ACTINIDE ELEMENT OXY-CATIONS. Vdovenko, V. M.; Vodovatov, V. A.; Mashirov, L. G.; Suglobov, D. N. Dokl. Akad. Nauk SSSR; 209: No. 2, 352-355(11 Mar 1973). (In Russian).

Infrared spectra were determined for a series of complexes of actinide elements of the four types: $RbMO_2(NO_3)_3$, $Cs_2MO_2Cl_4$, and $NaMO_2(CH_3COO)_3$, where M = Np, Pu, or Am; and $K_3MO_2F_5$ where M = Np or Pu. A 50% replacement of ^{16}O for ^{18}O was made in the MO_2^{2+} group; the methods of synthesis are outlined. The valence vibrations of the different isotopic forms of MO_2^{2+} and the force constants of the M-O bond are tabulated. The causes of the variations noted are discussed. (KSW)

10746 USE OF RADIOACTIVE KRYPTONATES TO SOLVE PHYSICOCHEMICAL PROBLEMS OF MACROMOLECULAR SUBSTANCES. II. Properties of Radioactive Kryptonates of Some Macromolecular Substances. Toelgyessy, J.; Cik, G.; Lesny, J.; Piatrik, M.; Varga, S. (Slovenskej Vysokej Skoly Technickej, Bratislava). Jad. Energ.; 19: No. 6, 201-202(Jul 1973). (In Czech).

Radioactive kryptonates of macromolecular substances were prepared by diffusion techniques and by ion bombardment. The dependence of the activity or its logarithm of kryptonates of polypropylene and poly(vinyl chloride) were studied as a function of time. This technique has possible uses in investigating irradiated polymers. (KSW)

10747 SHORT NOTE ON THE ACCURACY AND LINEARITY OF THE NEUTRON LIFETIME LOG RESPONSE. Wichmann, P. A. (Dresser Atlas, Houston, TX). pp 01-07 of Transactions of the SPWLA Fourteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1973).

From 14th annual logging symposium; Lafayette, Louisiana, USA (6 May 1973). See CONF-730521-.

Recent technical articles have raised several questions related to the accurate measurement of the thermal neutron capture cross section of fluid saturated rocks by pulsed neutron logs in general. A paper is presented that re-enforces the points previously made as to the accuracy of the Neutron Lifetime Log in relation to most of these questions and also presents additional data on the linearity and accuracy of the Neutron Lifetime Log (Dresser Atlas, Petroleum Services Division of Dresser Industries, Inc., trademark) measurement. It also provides new data that suggest a much lower level of oxygen activation gamma ray background than had previously been reported. (auth)

10748 EQUILIBRIA IN SOLUTIONS AND ANION EXCHANGE OF URANIUM(VI) COMPLEXES. IV. Stability Constants and Sorption of Uranyl Sulfate Complexes. Majchrzak, K. (Instytut Badan Jadrowych, Warsaw). Nukleonika; 18: No. 3, 105-119 (1973). (In Polish).

The sorption of uranium(VI) complexes on a strongly basic anion exchange resin was investigated. On the basis of the dependence of the uranium distribution coefficient on the SO_4^{2-} ions concentration, the stability constants of the uranyl sulfate complexes ($\beta_1 = 8{,}500$, $\beta_2 = 25{,}000$, $\beta_3 = 2{,}500$) and the selectivity coefficients of the sorbed complexes in relation to SO_4^{2-} ions ($K_2 = 2.7 \times 10^2$, $K_3 = 7.2 \times 10^3$), were calculated. The influence of the concentration of H_2SO_4 and of HSO_4^-, Cl^-, NO_3^-, and ClO_4^- anions on the uranium(VI) distribution coefficient values in Na_2SO_4 solutions is explained. (auth)

10749 INVESTIGATION OF URANYL NITRATE-TBP COMPLEXES IN HEXANE BY THE METHOD OF VAPOR PRESSURE LOWERING. Poczynajlo, A. (Instytut Badan Jadrowych, Warsaw). Nukleonika; 18: No. 4, 173-182(1973). (In Polish).

The measurements of relative vapor pressure in the systems TBP + hexane and $UO_2(NO_3)_2$ + TBP + hexane were performed using the Mechrolab 301A osmometer. Partial dimerization of tributyl phosphate ($k_{dim.} = 1.24 \pm 0.08$; temp = 25°C) was observed. The composition of uranyl nitrate + TBP complex in saturated solutions corresponds to the formula of the dissolvate. The equilibrium constant of $UO_2(NO_3)_2 \cdot 2TBP + TBP \rightleftharpoons UO_2(NO_3)_2 \cdot 2TBP \cdot TBP$ is equal to 5.7 ± 3.4 at 25°C. (auth)

10750 KINETIC STUDY OF THE OXIDATION OF p-HYDROQUINONE AND p-TOLUHYDROQUINONE BY NEPTUNIUM(VI) IN AQUEOUS PERCHLORATE MEDIA. Reinschmiedt, K.; Sullivan, C.; Woods, M. (Argonne National Lab., IL). Inorg. Chem.; 12: No. 7, 1639-1641(Jul 1973).

The oxidation of p-hydroquinone and p-toluhydroquinone by Np(VI) in aqueous perchlorate media can be described by the empirical rate law $-d[Np(VI)]/dt = k[Np(VI)][H_2Q]$ where H_2Q is the appropriate hydroquinone. At 25° and I = 1.00 values

determined for the rate parameters were $(4.52 \pm 0.24) \times 10^4$ M^{-1} sec^{-1} and $(6.26 \pm 0.33) \times 10^4$ M^{-1} sec^{-1}, respectively. No apparent effect of hydrogen ion was noted over the range $0.05 \leq [H^+] \leq 1.00$ M. Values calculated for ΔH^* (kcal/mol), ΔS^* (eu) were 8.17 ± 0.34, -9.8 ± 1.1 and 9.17 ± 0.29, -5.81 ± 0.97 for the p-hydroquinone- and p-toluhydroquinone-Np(VI) reactions, respectively. The results are discussed in terms of Marcus' cross-reaction equation for electron-transfer reactions. (auth)

10751 COORDINATED DISPROPORTIONATION OF SOLVATES OF URANYL CHLORIDE WITH NEUTRAL LIGANDS. Nikitina, S. A.; Lipovskii, A. A. Zh. Neorg. Khim.; 18: No. 6, 1617-1624 (Jun 1973). (In Russian).

The physicochemical behavior of uranyl chloride solvates ($UO_2Cl_2S_2$), where S is the neutral ligand, was investigated. The ligands chosen represented a wide range of electron-donor properties, and included TBP, the di-isoamyl ester of methylphosphoric acid, trioctylphosphine oxide, dioctylacetamide, and dioctylsulfoxide. The organic solvents employed for absorption spectra studies were the nonpolar C_6H_6 and the polar CH_3CN. The molar conductivity of the solvates was measured when dissolved in acrylonitrile. A rearrangement of the coordination sphere of the uranyl occurred: $2[UO_2Cl_2S_2] \rightleftharpoons [UO_2ClS_3]^+ [UO_2Cl_3S]^-$, the extent of which was determined by the nature of the neutral ligand, S. (KSW)

10752 HYDROXYOXYLATE COMPLEXES OF URANYL. Kuzina, M. G.; Lipovskii, A. A. Zh. Neorg. Khim.; 18: No. 6, 1625-1630(Jun 1973). (In Russian).

Uranyl hydroxyoxalate complexes with the tetradecylammonium cation (R) were formed in benzene and studied spectroscopically and by physicochemical analysis. Four soluble hydroxyoxalate complexes were detected: $(R_4N)_3(UO_2)_2$ Ox_2OH, $(R_4N)_5(UO_2)_2$ Ox_4OH, $R_4N(UO_2)OxOH$, and $(RN_4)_2UO_2$ $Ox(OH)_2$. The compound $R_4N(UO_2)_2$ Ox_2OH was insoluble in benzene. The character of the coordination of the ligands to the U atom was established by ir spectra. (tr-auth)

10753 HYDROPEROXYL RADICAL REACTIONS. I. Electron Paramagnetic Resonance Study of the Complexation of HO_2 with Some Metal Ions. Meisel, D.; Czapski, G.; Samuni, A. (Hebrew Univ., Jerusalem). Contract AT(11-1)-3221. J. Amer. Chem. Soc.; 95: 4148-4153(27 Jun 1973).

Complexes of HO_2 radical with the transition metal ions Th(IV), U(VI), Zr(IV), and Ti(IV) were generated in a flow system by mixing the corresponding metal ion either with HO_2 or with M–HO_2. The paramagnetic species were followed by EPR spectroscopy. The results indicate that both the exchange reaction M–HO_2 + M′ ⇌ M + M′–HO_2 and the formation reaction M + HO_2 ⇌ M–HO_2 are reversible fast processes. The mechanisms of these reactions were studied and the equilibria constants were determined. Values of $K_1 = (1.9 \pm 0.2) \times 10^{-2}$, $(1.8 \pm 0.2) \times 10^1$, and 3.6 ± 0.3 were determined for the couples Th(IV)–U(VI), U(VI)–Zr(IV), and Zr(IV)–Th(IV), respectively, and $K_2 = (2.7 \pm 0.4) \times 10^3$ and $(1.7 \pm 0.4) \times 10^5$ M^{-1} for M = U(VI) and Th(IV), respectively. Lower limits for the rate constants of these reactions were estimated. The decay of M–HO_2 was found to proceed through the free HO_2 radical as well as through the complexed form. Rate constants for the various modes of decay reactions in the presence of M = Th(IV) and U(VI) were determined. (auth)

Radioactive Waste Treatment

10754 (JPRS–58764) DISPOSAL OF RADIOACTIVE WASTES. 17 Apr 1973. Translation of Collection of Papers Sponsored by the State Committee for the Use of Atomic Energy of the USSR, 1972, Moscow. 71p. NTIS $5.75.

Separate abstracts were prepared for five IAEA papers dealing with radioactive waste processing and disposal. (DHM)

For abstracts of individual papers see: 10711, 10755–10757, and 11360.

10755 (JPRS–58764, pp 1-13) TECHNICAL AND ECONOMIC ASPECTS OF HANDLING LIQUID WASTE WITH INTERMEDIATE AND HIGH LEVELS OF RADIOACTIVITY. Spitsyn, V. I.; Khonikevich, A. A.; Balukova, V. D.; Nosova, L. M.; Rakov, N. A. 1972. Translation of SM–163/10.

Problems and economics of handling wastes of high and intermediate levels of radioactivity, obtained in the regeneration of fuel elements of water-cooled water-moderated power reactors are considered. For highly active wastes it is advisable to extract the Sr, Cs, and possibly other isotopes; and for the remaining part of the waste the following processes were considered: holding them in special depositories for a prolonged period of time, solidification of highly active wastes, and burial of highly active wastes in geological water-bearing strata. (DHM)

10756 (JPRS–58764, pp 36-46) TECHNICAL–ECONOMIC COMPARISON OF THE METHODS OF SOLIDIFICATION AND TANK STORAGE FOR HIGHLY ACTIVE LIQUID WASTES FROM THE PROCESSING OF SPENT FUEL ELEMENTS OF WATER-COOLED WATER-MODERATED POWER REACTORS. Azamayeva, L. G.; Il'ina, Z. G.; Kolosov, A. N.; Kondrat'ev, A. N.; Khodos, M. A.; Khonikevich, A. A. 1972. Translation of SM–136/31.

The analysis and technical–economic comparison made of methods of storage and vitrification of wastes with a high level of activity demonstrated that : (1.) The vitrification method makes it possible to bury highly active wastes for a prolonged period reliably. In this case the volume of the wastes is reduced by approximately a factor of 8 to 10. (2.) At the present time in the Soviet Union a technology has been developed and the development of equipment has begun for vitrification of highly active liquid wastes, which in the near future will make it possible to begin the construction of industrial plants. (3.) Expenditures on vitrification of liquid wastes with a high level of activity amount to ~1340 rubles per cubic meter (1.34 rubles per kilogram of fuel), which is somewhat below expenditures on storing them in stainless steel tanks (1510 rubles per cubic meter). (auth)

10757 (JPRS–58764, pp 62-70) DEVELOPMENT OF METHODS FOR PREPARING THE WASTES FROM HEXAFLUORIDE TECHNOLOGY FOR BURIAL. Krylova, N. V.; Kulichenko, V. V.; Martynov, Yu. P. 1972. Translation of SM–163/43.

Methods for preparing fluorator wastes and materials from sorption columns for burial are discussed. From data presented it was concluded that preparations of the cryolite type is recommended for fluorator wastes. The wastes are transferred from the fluorator into tanks, where they are mixed with inert additives. The mixing may be accomplished either by heating the wastes and flux by parallel additions, or by feeding the wastes into a flux that is already diluted. Further increase of the temperature to 900 to 1000°C, holding at this temperature (~1 hr), and cooling the fusion leads to the formation of a firm monolithic melt. The fusion of the charge may be conducted by an electric furnace or by decay heat. A burial space for cryolite preparations may be made in the form of steel pipes, whose external surface is cooled by air. It was concluded that for the disposal of materials from sorption columns (tablets of fluoride elements of the first and second groups of the periodic system) it is feasible to provide for burial of the sorbents directly in the sorption columns. (DHM)

10758 (ORNL-TM–4227) APPLICABILITY OF INORGANIC SORBENTS FOR TRAPPING RADIOIODINE FROM LMFBR FUEL REPROCESSING OFF-GAS. Ackley, R. D.; Combs, Z. (Oak Ridge National Lab., TN). May 1973. Contract W-7405-eng-26. 53p. At $5.45.

Possible sorbents for removing radioiodine from LMFBR fuel reprocessing off-gas were investigated. Sorbent-operating temperature combinations which were found effective in short-term laboratory tests for the trapping of iodine as methyl iodide or as elemental iodine were as follows: 27% AgX ($^1/_{16}$-in. pellets) at 200°C, 90% AgX ($^1/_{16}$-in. pellets) at 100 and 200°C, and GX135 (8 × 16 mesh, U.S.) at 100 and 200°C. The first two are silver–sodium zeolites. (The percentages indicate the degree of Ag^+ for Na^+ exchange.) The third is a silver salt-treated alumina–silica. Miscellaneous supplementary data and trapping results for certain other sorbent variations were also obtained and are presented as well. (auth)

10759 TREATMENT OF HIGHLY RADIOACTIVE LIQUID WASTES. Nosova, L. M.; Sedov, V. M.; Chonikevic, A. A. Arch. Energiewirt.; 27: No. 8, 398-404(1973). (In German).

Methods for treatment of high-activity liquid wastes (>1 Ci/l) from fuel reprocessing plants in the USA, France, Great Britain, and the German Federal Republic are described and compared. Storage in special containers, as well as methods of solidification and final storage of the solid wastes, are discussed. (GE)

Radioisotope Production

10760 (CONF-730908-1) ISOTOPIC ENRICHMENT OF THE PRODUCT OF A NEUTRON CAPTURE (n,γ) REACTION IN LANTHANIDE AND ACTINIDE EXCHANGED ZEOLITES. Campbell, D. O. (Oak Ridge National Lab., Tenn.). [nd]. 16p. Dep. NTIS $3.00.

From 3rd international conference on molecular sieves; Zurich, Switzerland (3 Sep 1973).

A reaction is reported that may yield useful amounts of the product isotope following neutron capture by lanthanide or actinide elements. The trivalent target ion is exchanged into Linde X or Y zeolite, fixed in the structure by appropriate heat treatment, and irradiated in a nuclear reactor. The (n,γ) product isotope, one

mass unit heavier than the target, is ejected from its exchange site location by gamma recoil. It may be selectively eluted from the zeolite. The reaction was demonstrated with several rare earths, americium, and curium. Products typically contain some 50% of the neutron capture isotope, accompanied by about 1% of the target material. The effect of experimental variables on enrichment is discussed. (auth)

10761 (DP-1269) ACTINIDE PROPERTIES AND METHODS OF PRODUCTION. Baxter, R. G. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Dec 1972. Contract AT(07-2)-1. 94p. Dep. NTIS $3.00.

The actinide series is composed of fifteen elements with atomic numbers 89 (actinium) to 103 (lawrencium). The principal naturally occurring actinides are ^{232}Th, ^{231}Pa, ^{235}U, and ^{238}U. Other actinides can be produced by irradiating heavy elements such as uranium with neutrons in a nuclear reactor, by bombarding nuclei with heavy ions in an accelerator, and by exposing heavy elements to very high neutron fluxes generated momentarily in thermonuclear explosions. The actinide elements are separated chemically by a combination of solvent extraction and ion exchange techniques. The nuclides ^{244}Pu through ^{257}Fm are produced by thermal neutron captures in reactors; ^{258}Md and higher nuclides are produced by heavy ion bombardment in accelerators. (auth)

10762 (RFP-Trans-131) PREPARATION OF PRACTICALLY CARRIER-FREE RADIO-COPPER ^{64}Cu WITH HIGH ACTIVITY FROM Cu-PHTHALOCYANINE. Herr, W.; Goette, H. Translated from Z. Naturforsch., 5a: 629-630(1950). 5p. Dep. NTIS $3.00.

Stable complex Cu-phthalocyanine compounds were irradiated using slow neutrons in the preparation of ^{64}Cu. Two methods for the separation of the carrier-free ^{64}Cu are described. (JGB)

Reactor Fuel Reprocessing

Refer also to abstract 11360.

10763 (BARC-643) PILOT PLANT FOR THE SEPARATION OF U-233 AT TROMBAY. Srinivasan, N.; Nadkarni, M. N.; Balasubramanian, G. R.; Chitnis, R. T.; Siddiqui, H. R. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 40p. Dep. NTIS (U. S. Sales Only) $4.00.

A pilot plant for the separation of ^{233}U from thorium and thorium oxide irradiated in CIRUS, Trombay was commissioned in August 1970. The process, the plant design, construction features, and the experience gained in operating such a facility are discussed. (auth)

10764 (BARC-656) IN-LINE ANALYTICAL METHODS FOR FUEL REPROCESSING STREAMS. Part II. Design and Working of a Simple Gamma Absorptiometer for Uranium. Rao, V. K.; Bhargava, V. K.; Marathe, S. G.; Iyer, R. H.; Ramaniah, M. V.; Srinivasan, N. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

The design and working of a simple gamma absorptiometer for the continuous monitoring of uranium in fuel reprocessing streams has been described. The unit consists of an encapsulated sample of ^{241}Am (~60 millicurie) as a source of soft gamma rays, a thin NaI (Tl) detector, a flow cell and an electrical readout system. Using this equipment, uranium could be determined in the 10 to 400 g/l range with an accuracy of the order of ±2 to 3%. Mass absorption coefficients for uranium as well as some principal light element constituents like H_2O, HNO_3, NO_3^-, $Al(NO_3)_3$, Al, TBP etc. were determined to evaluate the extent of their interference. Fission product activities of the order of 2 curie/litre could be tolerated at 100 to 150 g/l of uranium concentration within the accuracy limits mentioned. The gamma ray source movement was automated with a view to obtaining better source-detector geometry and also to reduce radiation hazard to operating personnel. The unit was plant tested in a pilot plant in Trombay and its usefulness for continuous monitoring of uranium concentrations as well as detection of malfunctions was demonstrated. (auth)

10765 (BARC-657) REMOVAL OF ENTRAINED TRIBUTYL PHOSPHATE IN AQUEOUS STREAMS USING A SPRAY COLUMN. Kumar, S. V. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 7p. Dep. NTIS (U. S. Sales Only) $3.00.

A spray column type of diluent wash unit is a simple and efficient way of removal of entrained tributyl phosphate from the aqueous streams of pulsed solvent extraction columns. The optimum aqueous velocity in these columns is between 0.38 to 0.42 $l/hr/cm^2$. (auth)

10766 (BARC-662) IN-LINE ANALYTICAL METHODS FOR FUEL REPROCESSING STREAMS. Part III. Gamma Monitoring of Fission Products. Marathe, S. G.; Bhargava, V. K.; Rao, V. K.; Iyer, R. H.; Ramaniah, M. V.; Srinivasan, N. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 26p. Dep. NTIS (U.S. Sales Only) $3.50.

A gamma monitoring assembly consisting of a movable shielded NaI(Tl) detector, a flow cell and an electrical read out system was fabricated and tested for the continuous monitoring of fission products in fuel reprocessing solutions. This unit in conjunction with a Ge(Li)-400 channel analyzer system can be used for the in-line monitoring of gross fiction products in the fuel reprocessing plants. Several synthetic fission product mixtures as well as actual plant solutions were analyzed using this setup under static conditions and it was demonstrated that solutions with gross activities in the range of 5 mc/l to 15 Ci/l can be monitored continuously with an accuracy of 10 to 20%. (auth)

10767 (BNWL-1741) RESEARCH AND DEVELOPMENT ACTIVITIES WASTE FIXATION PROGRAM. Quarterly Progress Report, December 1972-March 1973. Platt, A. M. (comp.) (Battelle Pacific Northwest Labs., Richland, Wash.). Apr 1973. Contract AT(45-1)-1830. 38p. Dep. NTIS $3.00.

A number of different borosilicate enamel-type formulations were investigated in which the major cations were lead, copper, or zinc. From these, a zinc borosilicate glass was selected for intensive study as a high-level waste fixation media. This glass forms fluid melts at 1150°C and can incorporate up to about 40 wt % waste calcine. With this type glass, the PW-6 (high sodium waste) product leachability is intermediate between Pyrex and bottle glass, where the PW-4b ("clean" waste) product leachability is comparable to that of Pyrex glass. Preliminary scoping studies conducted with PW-4b wastes in a fluidized bed at ICPP show promise of a workable flowsheet. Calcination of PW-6 waste presents an entirely different problem due to the presence of sodium nitrate. A PW-6 run conducted at 800°C, with aluminum nitrate added to form $NaAlO_2$, was successful. Core drill samples obtained from a canister of borosilicate glass (WSEP Spray In-Pot Melting Run SS-12) after 2.8 years of interim storage in air reveal no significant deterioration of the glass. Although there are many cracks and fractures within the glass, the thermal conductivity and leach rate of the glass have not changed and it does not appear to have devitrified. (auth)

10768 (DOCKET-50201-142) WEST VALLEY REPROCESSING PLANT. Technical Specifications, Change Request. (Nuclear Fuel Services, Inc., Rockville, MD). 17 May 1973. 4p. Dep. NTIS $3.00.

10769 (DOCKET-50332-29) BARNWELL NUCLEAR FUEL PLANT. Request for Extension of Construction Permit. (Allied-Gulf Nuclear Services, Barnwell, S. C.). 31 May 1973. 3p. Dep. NTIS $3.00.

10770 (DOCKET-50332-30) BARNWELL NUCLEAR FUEL PLANT. Supplemental General Information. (Allied-Gulf Nuclear Services, Barnwell, S. C.). 8 Jun 1973. 89p. Dep. NTIS $6.50.

Information is presented on Directors and Principal Officers of Allied-Gulf Nuclear Services, Gulf Oil Corporation, and Allied Chemical Nuclear Products Inc. and qualifications of personnel responsible for Barnwell Nuclear Fuel Plant. Copies of 1972 annual reports of Allied Chemical Corporation and Gulf Oil Corporation are also included. (DHM)

10771 (GERHTR-85) HIGH TEMPERATURE VOLATILIZATION OF NEODYMIUM FROM THORIUM CARBIDE PARTICLES. Podo, L. A.; Nickel, H. (Kernforschungsanlage, Juelich (West Germany)). Sep 1967. 25p. (JUL-502-RG-RW). Dep. NTIS (U.S. Sales Only) $3.25.

Work performed under United States-German High Temperature Reactor Research Exchange Program.

Substantial decontamination of thorium carbide from isotopes of neodymium was obtained by heating under vacuum at temperatures in the range 2000 to 2800°C. Sol-gel processes were adopted to prepare thorium carbide spherical particles containing 200 or 1000 ppM of neodymium. ^{147}Nd ($T_{\frac{1}{2}}$ = 11.1 d, γ = 0.53 MeV) was used as a tracer for radiometric determinations. (auth)

10772 REPROCESSING IN THE UNITED KINGDOM. Hine, A. R. (British Nuclear Fuels Ltd., Risley, Eng.). Kerntechnik; 15: No. 4, 157-159(1973).

Successful operation of the Windscale Oxide Fuel Reprocessing Plant since 1969 has allowed improved, more efficient procedures to be developed. As a result work has now been put in hand which will increase throughput to 400 t/a. BNFL have development work in progress aimed at a replacement for this plant in about 1980, a fast reactor reprocessing plant in the late 1980s and plan work shortly on a progressive change over from liquid to solid highly active waste storage. (GE)

ENGINEERING

Energy Conversion

Refer also to abstracts 11215 and 12579.

10773 (JPRS-59266) THERMODYNAMIC CYCLES OF ATOMIC POWER PLANTS WITH MHD GENERATORS. Dekhtyarev, V. L.; Khalaydzhi, V. N.; Smolkin, Yu. V.; Kopp, I. Z. Translated from Teplofiz. Vys. Temp.; 11: No. 2, 385-389(1973). 8p. Dep. NTIS (U. S. Sales Only) $3.00.

The feasibility of using gaseous magnetohydrodynamic generators at nuclear power plants is discussed. (auth)

10774 (NAA-SR-11760(Vol.1)) ADVANCED THERMOELECTRIC DEVELOPMENT PROGRAM PROGRESS REPORT, NOVEMBER 1965-JANUARY 1966. Gill, J.; Blevitt, R. (Atomics International, Canoga Park, Calif.). 31 Mar 1966. Contract AT(11-1)-Gen-8. 45p. Dep. NTIS $4.25.

Declassified 24 May 1973.

Program effort during the quarter was concentrated on continuing the evaluation of bonds and materials both at design and accelerated thermal conditions. Effort also was continued on developing fabrication techniques for 2- and 8-couple evaluation modules. Accelerated and long-term test data continued to demonstrate the capability of materials and bonds used in the advanced module design to meet the program objectives. As part of the effort to develop processes for test module fabrication, approximately twenty 2-couple modules and one 8-couple module were fabricated. Difficulties experienced with cracking at the cold junction were eliminated by introducing minor modifications in design and processing. Process development efforts currently are concentrating on minimizing cracking of the beryllia insulator. (TFD)

10775 (NAA-SR-12016(Vol.1)) ADVANCED THERMOELECTRIC DEVELOPMENT PROGRAM. Progress Report, February 1966-April 1966. Blevitt, R.; Gill, J. (Atomics International, Canoga Park, Calif.). 15 Jul 1966. Contract AT(11-1)-GEN-8. 55p. Dep. NTIS $4.75.

Declassified 17 Apr 1973.

Activities during this reporting period were directed primarily toward the development of fabrication techniques for producing 2- and 8-couple evaluation modules. In the development processes of these laboratory type assemblies, 27 two-couple and 13 eight-couple structures were fabricated. Development efforts to minimize BeO insulator cracking were successful and have led to modification of the reference design lower stack bond system. Accelerated testing of bonds and materials time-temperature capabilities was continued during the quarter and firmly established the reference materials and bonds as capable of meeting the program objectives. Initial thermal and tensile tests of 2-couple modules of the present reference design demonstrated that the fabrication processes yielded modules capable of meeting program objectives. Current efforts are concentrating on the fabrication and installation of modules for test and evaluation. (TFD)

10776 (NAA-SR-12016(Vol.2)) ADVANCED THERMOELECTRIC DEVELOPMENT PROGRAM. Progress Report, February 1966-April 1966. (Atomics International, Canoga Park, Calif.). 15 Jul 1966. Contract AT(11-1)-Gen-8. 62p. Dep. NTIS $5.25.

Declassified 24 May 1973.

During the quarter the major effort was directed toward developing laboratory assembly processes which resulted in techniques for fabricating eight-couple developmental modules for performance testing and evaluation and selection of a modified reference design. (TFD)

10777 MAGNITOGIDRODINAMICHESKIYE GENERATORY. (Magnetohydrodynamic Generators). Yantovskii, E. I.; Tolmach, I. M. Moscow; Izdatel'stvo Nauka (1972). 424p.

Broad aspects of hydrodynamic generators are reviewed and definite conclusions about each topic are presented. (TFD)

10778 EFFECT OF IONIZATION TURBULENCE ON THE OPERATION OF AN MHD GENERATOR OPERATING WITH A NONEQUILIBRIUM PLASMA. Zampaglione, V. (Lab. for the Direct Conversion of Energy, Rome). High Temp. (USSR) (Engl. Trans.); 10: No. 6, 1053-1057(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 6, 1171-1175 (1972).

The article gives a refined evaluation of the effect of ionization turbulence on the operation of a magnetohydrodynamic generator working with a nonequilibrium plasma. Calculations based on approximated models of a turbulent plasma are given. (auth)

10779 EFFECTS OF CHANNEL SIZE ON THE IONIZATION INSTABILITY IN MHD GENERATORS. Evans, R. M. (Naval Postgraduate School, Monterey, CA); Kruger, C. H. AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 11: No. 7, 1006-1012(Jul 1973).

An experimental and theoretical study of the ionization instability in nonequilibrium, continuous-electrode MHD generators is presented. Experiments have been conducted in flowing, atmospheric-pressure argon at 2100°K seeded with 0.1% by mole potassium to investigate the influence of electrode separation on the development and effects of the ionization instability. A two-dimensional, linear perturbation analysis of the governing equations was developed to predict the dependence of the critical Hall parameter for growth of the instability on the electrode separation, current density, and magnetic field. Essential to the analysis is the retention of the radiation and heat conduction terms of the energy equation. The experiment and theory were in general agreement and showed that the wavelength decreased with increasing magnetic field, increasing current density, or decreasing electrode separation. The critical Hall parameter was found to decrease with increasing electrode separation and to vary with the current density. From the experiments it was found that the effective Hall parameter decreased with increasing magnetic field or increasing electrode separation. The effective scalar conductivity showed no appreciable change for the three electrode separations. (auth)

10780 NUMERICAL METHOD OF SOLUTION OF SOME NONLINEAR BOUNDARY-VALUE HEAT AND MASS TRANSFER PROBLEMS. Filippov, S. S. (Inst. of Applied Mathematics, Moscow). Inzh.-Fiz. Zh.; 24: No. 4, 756-760(Apr 1973). (In Russian).

An example of a one-dimensional boundary-value problem, the numerical method of solution of some nonlinear boundary-value problems in the theory of heat mass transfer is presented. This method is based on the method of establishment. An implicit difference scheme is constructed by the Tikhonov-Samarsky integro-interpolation method and is solved using a matching procedure. The possibility is shown to extend the method to two-dimensional problems. The main advantages of the method are discussed and results of comparison with other methods, when solving the problem of liquid flow with temperature-dependent transport coefficients in MHD-channels, are considered. (auth)

Facilities and Equipment

Refer also to abstracts 10763, 11106, 11217, 12049, 12057, 12157, 12158, 12162-12166, 12489, and 12591.

10781 (EUR-4820(Vol. 5)(Pt. K), pp 155-174) RESPONSE SPECTRUM ANALYSIS TO AN ARTIFICIAL EARTHQUAKE WITH TWO GROUND PREDOMINANT PERIODS. Sato, H. (Tokyo Univ.). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Analysis of the response spectrum of a structure system simulated by one-degree-of-freedom to an artificial earthquake, stationary random vibration with two ground predominant periods is made. This is investigated as the extensive study for the case of single predominant period. Then for the estimation of maximum of the artificial earthquake and response wave form the probability density function of extreme is made use of. According to this analysis both spectra show good coincidence about their shape which could not be seen in the analysis by single ground predominant period. For the case that the structure system has nonlinearity of elasto-plastic characteristic the response spectrum of velocity and displacement in terms of standard deviation is obtained. However general characteristic of the spectrum is same as that for single ground predominant period, the results of the analysis show better agreement with the spectrum to actual earthquake record than those by single ground predominant period did. The expectation and the variance of the spectrum are obtained by assuming probability density function for realization of system parameters as ground predominant period, natural period and damping ratio of structure model. Considering the existence of two ground predominant period close to each other suggests that seismic force does not vary irrespective of the fluctuation of the system parameter. (auth)

10782 (EUR-4820(Vol. 5)(Pt. K), pp 195-209) ANALYSIS OF SOIL-STRUCTURE INTERACTION EFFECTS UNDER SEISMIC EXCITATION. Costantino, C. J. (City Coll., New York). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A numerical technique to treat the complete dynamic soil-structure interaction problem is described. The structure embedded within the free-field soil system is represented by its rigid body and elastic free-free modes, while the soil is treated by the finite element method including nonlinear material properties. The application of the developed computer program, termed the SLAM Code for identification, to a particular problem incorporates the ability for treating potential separation and sliding between the soil and the structure. The results obtained for a particular structural response problem indicate that the rocking motion induced in the facility from a seismic input magnifies the motion of the structure at points away from the center of gravity. This magnification increases the severity of the structural motion by an order of magnitude. (auth)

10783 (EUR-4820(Vol.6)(Pt.M), pp 229-244) ANALYSIS OF NONLINEAR THERMOVISCOELASTIC AND THERMOPLASTIC BEHAVIOR OF SOLIDS OF REVOLUTION BY THE FINITE ELEMENT METHOD. Oden, J. T.; Chung, T. J.; Key, J. E. (Univ. of Alabama, Huntsville). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

General finite element models for the analysis of a broad class of nonlinear problems in finite thermoelasticity, thermoviscoelasticity, and thermoplasticity are derived. Numerical results obtained from a number of example problems are given. (auth)

10784 (EUR-4820(Vol.6)(Pt.M), pp 245-260) STRESS ANALYSIS OF COMPLEX STRUCTURES IN PRESENCE OF CREEP, DIMENSIONAL CHANGES, AND A THERMAL FIELD. Donea, J. M.; Giuliani, S. (Euratom, Ispra, Italy). Mar 1972. (In French).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A computer code for the stress analysis of complex structures in presence of creep, dimensional changes, and a thermal field is presented. The computer program was developed for solving two-dimensional problems, i.e., problems with plane stress, plane strain, generalized plane strain or axisymmetric deformations. The variational problems associated with the determination of temperature and displacement fields within the structure are solved by the finite-element method using automatically generated triangular elements. The material is assumed to be transversely isotropic, while creep strains and dimensional changes are treated as incremental-initial strains. The program has been conceived so that any laws of material behavior can easily be incorporated. The range of applicability of the computer program is illustrated by means of practical examples. (auth)

10785 (EUR-4820(Vol.6)(Pt.M), pp 305-314) TWO-DIMENSIONAL PROBLEMS OF PLASTICITY IN SOLIDS WITH DYNAMIC EFFECTS. Costes, D. (CEN de Saclay, Gif-sur-Yvette, France). Mar 1972. (In French).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Two codes are presented for two-dimensional problems of plasticity in solids, with dynamic and temperature effects. The PLASTI code includes a lumped mass schematization with triangular element and is more adapted to thick body problems. The PLASCOQ code also includes a lumped mass schematization, the wall of the body being composed of three layers (a neutral layer and two skin layers) without relative sliding. Each of the triangles in PLASTI or layers in PLASCOQ behaves plastically. The plastic behaviour follows Von Mises and Levy laws, with isotropic strain hardening, without Bauschinger effect. (auth)

10786 (EUR-4820(Vol.6)(Pt.M), pp 337-364) METHOD TO GENERATE BOTH UPPER AND LOWER BOUNDS TO PLATE EIGENVALUES BY CONFORMING DISPLACEMENT FINITE ELEMENTS. Lynn, P. P. (Univ. of Colorado, Boulder); Ramey, G. E. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Due to the approximate nature of the finite element method, the generation of both upper and lower bounds to the exact solution is of great value in ascertaining the accuracy of the approximation. This is particularly true for eigenvalue solutions. A method, using only the conforming displacement elements, for determining both bounds is presented. The first solution bound is obtained immediately from the finite element numerical solution. The second bound is generated by using the first bound numerical results for two or more mesh sizes. For large value of n (n is a measure of the number of elements used) the method is mathematically defensible. For small values of n certain assumptions have to be made. The bounding of the exact solution can be proved by assuming the validity of these assumptions. The method was extensively tested on both free vibration and buckling plate problems to assure its workability. Results of these tests reveal that within practical element subdivisions the technique generally guarantees the generation of the other bound; but for extremely coarse finite element approximations, a caution has to be exercised. For the latter case, a supplementary scheme to increase the effectiveness of the method is provided. The method works extremely well in static problems, and the attainment of the other bound for these problems can be shown mathematically. (auth)

10787 (EUR-4820(Vol.6)(Pt.M), pp 390-408) SPECIAL FINITE ELEMENTS FOR THE ANALYSIS OF STRESS CONCENTRATIONS AND SINGULARITIES. Rao, A. K.; Krishna Murty, A. V.; Raju, I. S. (Indian Inst. of Sci., Bangalore). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

In matrix formulations, each region of stress concentration requires the use of a large number of small conventional finite elements, and often, the advantage of a fine mesh can be overcome by numerical errors. The situation can be particularly difficult in the presence of elastic stress singularities. A method was developed to overcome this difficulty; a fairly large element replaces a large number of the conventional small elements in each region of concentration. The displacement or stress description of this large element includes terms that represent the nature of the local concentration. A method for developing such a large finite element and applying it is described and illustrated by typical examples. Some of the solutions are compared with conventional finite element solutions. (auth)

10788 (EUR-4820(Vol.6)(Pt.M), pp 425-441) APPLICATION OF FINITE ELEMENT ELASTIC-PLASTIC STRESS ANALYSIS TO NOTCHED FATIGUE SPECIMEN BEHAVIOR. Mowbray, D. F.; McConnelee, J. E. (General Electric Co., Schenectady, NY). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Finite element elastic-plastic stress analyses were performed on several notched fatigue specimen geometries used in a test program to determine the notched fatigue strengths of three common low strength structural steels. The analyses are for monotonically applied loading, with the cyclic nature of fatigue loading considered by using "cyclic" stress-strain curves as effective stress-strain relationships. The calculated notch root strains are found to agree well with experimental measurements. Further, a good correlation of the fatigue crack initiation life data for smooth and notched specimen of these steels is found to result when the controlling variable is considered to be effective stress-amplitude at the specimen surface. (auth)

10789 (EUR-4820(Vol.6)(Pt.M), pp 442-462) DIRECT FLEXIBILITY FINITE ELEMENT ELASTOPLASTIC ANALYSIS. Gallagher, R. H. (Cornell Univ., Ithaca, NY); Dhalla, A. K. Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The direct flexibility method, a finite element procedure for complementary energy solutions, is formulated for the elastoplastic plane stress analysis. Flexibility relationships are derived for a rectangular element, using an Airy stress function representation which corresponds to the displacement field representation for an inter-element-compatible rectangle in bending. This model enables satisfaction of equilibrium conditions in both the local and global sense, exclusive of boundary conditions. The constitutive relationships of incremental plasticity theory, with the Prandtl-Reuss flow rule, are utilized in conjunction with an initial stress approach in application to elastoplastic analysis. Illustrative examples are performed and the results compared with alternative solutions. (auth)

10790 (EUR-4820(Vol.6)(Pt.M), pp 463-484) SYSTEMATIC ENFORCEMENT OF STRESS BOUNDARY CONDITIONS IN THE ASSUMED STRESS HYBRID MODEL BASED ON THE DEFORMATION METHOD. Wolf, J. P. (Digital Ltd., Zurich). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The favorable influence of the enforcing of stress boundary conditions in the assumed stress hybrid model is demonstrated with examples of singular behavior. A systematic procedure of satisfying the stress boundary conditions exactly is described. (auth)

10791 (EUR-4820(Vol.6)(Pt.M), pp 503-519) USE OF ANALYTIC CONTINUATION IN SOLUTIONS OF PLANE THERMOELASTIC PROBLEMS ON DOUBLY CONNECTED REGIONS. Sekiya, T.; Sumi, N. (Univ. of Osaka Prefecture, Sakai, Japan). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The method of analytic continuation is applied to the plane thermoelastic problems on doubly-connected regions, which are the steady temperature fields without any heat generation at the inner points. Starting from Muskhelishvili's basic equations of two-dimensional-thermoelasticity and following after Buchwald's and Davies' approach, one of two complex potentials is continued analytically into the inverse region across one of the boundaries which is a circle or can be mapped on to a circle. Then the conditions on the circular boundary are satisfied exactly and it is only necessary to consider the conditions on the outer boundary. The procedures are illustrated by solutions for the elliptic regions with a confocal elliptic hole and polygonal regions with a circular hole at the center. In each region the boundary conditions are considered for two cases: the case of both boundaries free; and the case of the inner boundary free and the outer boundary fixed. In the first case, the results of present paper are compared with the former results, obtained using the point-matching method for real stress functions and the mechanical analog procedure, by authors and others. (auth)

10792 (EUR-4820(Vol.6)(Pt.M), pp 525-537) APPLICATION OF WORK THEOREMS TO THE METHODS OF SINGULARITIES. Krawietz, A. (Technische Univ., Berlin). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A procedure is presented, applicable to each self-adjoint linear elliptic differential equation, for which a fundamental solution can be given, but mainly commendable for the most simple and important ones: the potential and bipotential equation in two independent variables with any secondary conditions. Shape and connectivity of the region are arbitrary. The lines of boundary and intermediate conditions are laid with a linear combination of standard singularities (redundancies). The character of the required singularity distribution depends on the local qualities of these lines (e.g., on the amount of polygonal angles), but not on the global region. The redundancies are calculated from a symmetrical system of linear work equations, well known from the statics of beams. The values of the function and its derivatives for every desired point are obtained by superposition of the analytic standard functions. The application of the procedure demands the use of electronic digital computers. The input includes a complete description of the problem (region and secondary conditions), but no other preliminary work has to be done. (auth)

10793 (EUR-4820(Vol.6)(Pt.M), pp 539-553) STATISTICAL AVERAGE RESPONSE OF A BOUNDED STOCHASTIC LINEARLY ELASTIC SOLID. McCoy, J. J. (Catholic Univ. of America, Washington, DC). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The problem considered is the response of linearly elastic solids that possess material parameters that vary with position in an irregular fashion. A multiphase composite or a polycrystal are specific examples of this class of solids. A proper description of such a medium requires the introduction of the language of stochastic processes to define the spatially varying properties. This, in turn, requires that we think of the response only in statistical terms. The coarsest statistical information is contained in the statistical average. Fortunately, in our problem, the most important information is also contained in the statistical average. A proper formulism for predicting the average response of the above described medium is considered. In earlier papers, the identical problem was posed for the special case in which the solids are of infinite extent. The resulting formulism, which has the form of a nonlocal theory, was shown not only to be valid for this limiting case but for bounded solids as well so long as predictions are not to be made of the response in the immediate vicinity of the boundaries. This restriction is unfortunate since it is exactly in the vicinity of boundaries that most failures begin. It is to understand what happens in these boundary layers that the present effort is directed. Specifically, the problem involves a solid in which the inhomogeneities are restricted to exist in a region bounded by two concentric spheres. Outside this region the solid is homogeneous. The far field state of stress is hydrostatic. (auth)

10794 (LA-5207-MS) HEAT LOSS CALCULATIONS FOR SMALL DIAMETER SUBTERRENE PENETRATORS. Murphy, D. J.; Gido, R. G. (Los Alamos Scientific Lab., N. Mex). Feb 1973. Contract W-7405-eng-36. 15p. Dep. NTIS $3.00.

Thermal analyses are discussed which illustrate that the heat losses to the rock surrounding small-diameter, refractory metal, prototype Subterrene rock-melting penetrators can be predicted. A simplified right-cylinder model configuration is considered. The results of a parametric study of the heat loss as a function of penetrator diameter and length, penetration rate, rock-melting temperature, and rock thermal properties are presented. The demonstrated ability to predict the thermal performance of a penetrator establishes the possibility of optimizing the system. Increased thermal efficiency for higher penetration rates is predicted. Calculated and experimental heat-loss values are shown to agree well. (auth)

10795 (LA-5210-MS) LARGE SUBTERRENE ROCK-MELTING TUNNEL EXCAVATION SYSTEMS. A Preliminary Study. Hanold, R. J. (Los Alamos Scientific Lab., N. Mex.). Feb 1973. Contract W-7405-eng-36. 35p. Dep. NTIS $4.00.

The application of the rock-melting concept to large, continuous tunneling machines was studied. System objectives and requirements for an innovative excavation system were outlined along with a group of particularly costly and perplexing problem areas in conventional tunneling technology which appear to be amenable to solution by the rock-melting concept. Specific data on the established performance of conventional tunnel-boring machines are presented, particularly with regard to advance rate, cutter performance, power consumption, and overall system behavior. Difficulties currently encountered in tunneling in either loose unconsolidated ground or hard abrasive rock are indicated along with representative cost data. Various penetration modes included in the rock-melting concept are described, and associated power-source requirements are discussed. The technique of kerf melting is analytically treated, and conceptual melting-face configurations for a soft-ground and hard-rock-melting tunneler are presented. The utilization of a compact heat-pipe-cooled nuclear reactor to supply the energy for a large-diameter melting tunneler advancing at a high rate is discussed. The unique advantages of high-temperature heat pipes delivering high energy densities to the penetrator melting face are indicated. The utilization of rock-melt debris to form a structural glass tunnel lining and fluidized pipeline material removal techniques are discussed for a well-matched continuous tunneling machine. (auth)

10796 (WASH-1244) STATE OF THE ART OF SALTWATER COOLING TOWERS FOR STEAM ELECTRIC GENERATING PLANTS. Roffman, A.; (and others) (Westinghouse Electric Corp., Pittsburgh, PA. Environmental Systems Dept.). Feb 1973. Contract AT(11-1)-2221. 434p. Dep. NTIS $10.60.

This review of the state-of-art of saltwater cooling towers applicable to steam electric power generating plants includes information obtained from the literature and from cooling tower manufacturers and users. Presently there are very few saltwater towers anywhere in the world, and none in the size range that would be necessary for use in a large steam electric power generating plant. Also, there is practically no experimental field data available regarding cooling tower salt drift, its deposition or its impact on the environment. The information presented is based upon available experimental information and analytical predictions. (TFD)

10797 (Y-1881) SIDESTREAM FILTRATION OF COOLING TOWER WATER. Schmitt, C. R. (Oak Ridge Y-12 Plant, TN (USA)). 29 Jun 1973. Contract W-7405-eng-26. 23p. Dep. NTIS $4.00.

Laboratory performance tests were conducted with a column of filter sand to evaluate the suitability of the sand grains (0.3 to 0.8 mm in diameter) for use in automatic and valveless sidestream filter installations for removing suspended solids from cooling-tower water systems. Analytical studies were made on samples of cooling water and suspended solids from two 10-ft-diameter by 15-ft-high sidestream filter installations to identify the type and particle-size range of particulates being removed by the filters. Particle-size range of the removed suspended particulates was approximately 5 to 32 micrometers in diameter; and, after the first year of operation, the filters have continued to provide satisfactory and maintenance-free operation. (auth)

10798 SPETSIAL'NYE GIDROTEKHNICHESKIE SOORUZHENIYA NA ATOMNYKH PREDPRIYATIYAKH. (Special Hydraulic Engineering Facilities for Atomic Operations). Kuzovlev, G. M. Moscow; Atomizdat (1973). 400p.

As a result of the construction of high-level power generation units operating on nuclear fuels, many special hydraulic engineering problems have arisen. The design of facilities for the storage and transport of radioactive liquids is considered, and several allied topics are treated, e.g., movement of radioisotopes in ground waters, hold-up and emergency storage basins, and the physicochemical properties of concrete. About 50 pages of appendices offer tables of data and brief summaries of special materials, e.g., water-resistant coatings, special welding techniques, protection of concrete, and numerical values of pertinent functions. 210 references. (KSW)

Heat Transfer and Fluid Flow

Refer also to abstracts 10780, 10794, 12069, and 12476.

10799 (EUR-4820(Vol.6)(Pt.M), pp 141-164) TREATMENT OF THREE-DIMENSIONAL HEAT CONDUCTION AND THERMOELASTIC PROBLEMS BY THE FINITE ELEMENT METHOD. Naehrig, T. K.; Gaschen, J. P. (SDK Ingenieurunternehmen fuer Spezielle Statik, Dynamik und Konstruktion, Loerrach, Ger.). Mar 1972. (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Finite element techniques are conveniently applied to those physical problems which can be described by means of variational problems. Since the variation integral can only be formulated directly when the functional itself has a physical meaning, the conditions for the formulation and the existence of an equivalent variational problem as such are discussed. The variation integral for a transient heat conduction problem is formulated, taking anisotropic material behavior and temperature-dependent heat sources into account. The functionals for less complex cases can be easily derived. The application of the finite element method is described. Here, as well as for thermoelastic problems which are treated briefly, the generalized Ritz-equations are assumed to be first-order polynomials. They are applied to the basic element, a four-noded tetrahedron. An approach for the composition of so-called "superelements" is presented. Averaging techniques are applied for the computation of the distribution and stiffness matrices. Using a cube as a possible superelement it is shown that absolute symmetry is guaranteed and that the deformation energy for a particular averaging technique reaches a minimal value. The treatment of the element and the admissibility of the steps taken with respect to continuity conditions are discussed. The application of a so-called block-iterative method to large linear equation systems occurring in 3-dimensional finite element calculations is outlined, for which results have been very satisfactory. Finally, some results for a heat exchanger calculation are presented. Difficulties which arose during the calculation are pointed out and suggestions are made which will help avoid these problems in the future. (auth)

10800 (EUR-4820(Vol.6)(Pt.M), pp 165-184) COMPUTATION OF TEMPERATURE DISTRIBUTIONS AND THERMAL STRESSES USING FINITE ELEMENT TECHNIQUES. Fullard, K. (Central Electricity Generating Board, Berkeley, Eng.). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A description is given of a method for calculating transient temperature distributions within structures of arbitrary shape by means of finite element techniques. Two typical nuclear applications, a cylinder-sphere intersection and a cylinder-cylinder intersection are used to illustrate the method. Thermal stresses in these structures are indicated and compared. (auth)

10801 (EUR-4820(Vol.6)(Pt.M), pp 185-205) TRIDIMENSIONAL THERMOELASTIC COMPUTER CODE "TITUS". Launay, P.; Charpenet, G.; Vouillon, C. C. (Compagnie Industrielle de Travaux, Paris). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The TITUS system is a program package permitting processing on a computer of a wide range of problems in the fields of theory of elasticity, strength of materials, thermic and thermoelasticity. The basic options chosen, the level of theory adopted, processing methods, programming or functional organization on computers are described. Stress is placed on the ease of using the system, obtained by the great flexibility of inputs and outputs, and organized so that TITUS constitutes a tool with many possibilities insofar as both computations and dialogue with the user are concerned. Examples of structures designed with the TITUS system at CITRA are given as examples. (auth)

10802 (EUR-4820(Vol.6)(Pt.M), pp 489-502) METHOD OF SOLUTION OF THE LINEAR BOUNDARY PROBLEMS OF HEAT CONDUCTION, THERMOELASTICITY, AND VISCOELASTICITY. Rafalski, P. (Inst. of Nuclear Research, Swierk, Poland). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The application of the method of orthogonal projection in the Hilbert space to three linear boundary problems arising in nuclear reactor design, i.e., the non-stationary heat conduction problem, the dynamic thermoelastic problem, and the dynamic viscoelastic problem, is described. To develop the method, the leading idea of the method of orthogonal projection for Dirichlet problem and the concept of operational calculus of Mikusinski is used. The Hilbert space of generalized functions is defined and thereafter is decomposed into the orthogonal sum of two subspaces, i.e., the subspace of generalized functions satisfying the differential equation and the subspace of generalized functions vanishing on the boundary. The orthogonal projection of the generalized function representing the boundary conditions on the first subspace is the solution of the problem. The above fundamental theoretical treatment leads directly to the computer method of solution, which is proposed in the sequel. Two complementary ways to construct a sequence of approximations for a three-dimensional non-stationary problem, e.g., the Trefftz method and the Ritz method are presented. The method has the virtue of giving a measure of error for any approximated solution. (auth)

10803 (KFK-1779) HYPOTHESIS ABOUT NUCLEATION BOILING EVENTS OCCURRING AT PHASE BOUNDARIES. Class, G.; Schultheiss, G. F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Apr 1973. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

Wetting conditions in a system of microcracks in the range of solid surfaces are proposed as a basis for explaining the familiar phenomenon that the generation of boiling nuclei is greatly favored in heterogeneous systems. Within such microcracks, which either exist or are generated in the process, the wetting angle between the solid wall and the liquid is influenced by the process itself and can reach or even exceed 90°. Local adsorption and absorption processes are believed to be responsible for this behavior. This, together with the effect of spontaneous nucleation in the submicroscopic range, gives rise to a hypothetical model of nucleation with dynamic characteristics, especially with respect to the existence of individual nucleation sites. In this way, the statistical behavior of macroscopic critical vapor nuclei (such as variations of boiling superheat and delay times) can be explained. (auth)

10804 DEVELOPMENT OF THE SCIENCE OF HEAT AND MASS TRANSFER. A Survey. Luikov, A. V. Heat Transfer-Sov. Res.; 5: No. 2, i-ix(1973).

A review on the science of heat and mass transfer as one of the principle theoretical foundations for the development of thermal protection of spaceships and missiles, design of structural elements for supersonic aircraft, jet engines, and nuclear reactors is presented. (TFD)

Materials Testing

Refer also to abstracts 10952, 11218, 11243, and 12593.

10805 (SGAE-2100) ON-LINE DETERMINATION OF SPHERICITY, COATING THICKNESS, AND DENSITY OF FUEL PARTICLES. Koss, P.; Wallisch, K. (Oesterreichische Studiengesellschaft fuer Atomenergie G.M.B.H., Seibersdorf). Feb 1973. 9p. (CONF-720475-2). Dep. NTIS (U. S. Sales Only) $3.00.

From fourth meeting of the Dragon Project Quality Control Working Party; Grenoble, France (19 Apr 1972).

A fast optical method for determining thickness and density of coatings is described. Two diameters of a particle, perpendicular to each other, are measured simultaneously at a rate of 20 particles per second. The weight of each batch and the number of particles it contains are determined. By hot extraction of samples between each coating step, the apparent thickness and density of the coating as well as the deviation from specification can be calculated by the on-line computer (PDP-8/E). This information can be used for process control. (auth)

10806 DETERMINATION OF DEFECT DEPTH AND ATTITUDE BY THE RADIOMETRIC METHOD. Braslavskii, G. D.; Gorbunov, V. I. (Tomsk Polytechnic Inst., USSR). Defektoskopiya; No. 2, 140-141(1973). (In Russian).

The relative advantages of employing a single beam of γ-radiation in ascertaining the depth and orientation of a defect versus a dual beam of betatron radiation are discussed. Target placement and attitude, optimum angle between the intersecting radiation beams, and the optimum arrangement of the detecting devices are evaluated with the use of the mathematical relationships involved. (KSW)

10807 INCREASING DETECTION SENSITIVITY FOR CERTAIN TYPES OF FLAWS WITH A TWO-BEAM BETATRON. Braslavskii, G. D.; Gorbunov, V. I. (Tomsk Polytechnic Inst., USSR). Defektoskopiya; No. 2, 138-140(1973). (In Russian).

Unfavorable orientation of certain flaws renders them difficult to detect; accordingly a dual beam betatron is suggested which would furnish two intersecting beams of γ-radiation and enhance the sensitivity required for this type of defect. The geometry of the dual beam device is explored in terms of crack dimensions, thickness of the part under examination, and the angle between the γ-radiation beams. (KSW)

10808 TIME CONSTANT CORRECTION FOR THE SMOOTHING FILTER IN SCINTILLATION GAMMA FLAW DETECTORS. Troitskii, I. N. Defektoskopiya; No. 2, 88-92(1973). (In Russian).

The problem concerning the optimum choice of the time constant for a linear filter during the transition from defect detection to the identification and measurement of its parameters is discussed for the case when the fluctuations in the signal received are substantial. For this situation it is proposed to determine the optimum value for the time constant by minimizing the root-mean-square deviations of the recorded signal from the signal which carries undistorted information concerning the shape of the defect. The expressions derived permit an analysis of the root-mean-square deviations and to determine the optimum time constant as a function of the power level of the radiation source. (tr-auth)

10809 RADIOMETRIC QUALITY CONTROL METHOD OF INGOTS IN CONTINUOUS TEEMING OF RIMMING STEEL. Valuev, N. P.; Latyshev, V. K.; Lyndin, V. V. (Central Research Inst. of Ferrous Metallurgy, Moscow). pp 266-273 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973). (In German).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

Two methods of checking the depth of honeycomb blowholes in ingots of rimming steel in the process of continuous teeming are described. The first method is based on scanning ingots by a beam of hard gamma rays. The choice of measurement geometry ensuring the maximum sensitivity in checking ingots having a thickness of up to 230 mm is substantiated. Using the collimation spectrometric method of forming the scanning beam, it was possible to measure the depth of honeycomb blowholes to within ±2 mm at a scanning rate of 5 mm/s and integrator time constant of 1 s. The radiation source was ^{137}Cs with an activity of 5 Ci or ^{60}Co with an activity of 0.3 Ci. The use of gamma backscattering to check the depth of blowholes over a wide ingot face was investigated. It is shown that the best results are obtained by measuring the gamma-albedo in a particular spectrum region most sensitive to the presence of blowholes in the scattering area. With a 0.3 Ci ^{60}Co source, the depth of blowholes in the 10 to 25 mm range can be checked to within 3 to 4 mm with a measurement time of 2 to 3 s. (auth)

10810 ADVANCES IN COMPUTATIONAL METHODS IN STRUCTURAL MECHANICS AND DESIGN. 2nd US-Japan Seminar, Berkeley, California, August 1972. Oden, J. T.; Clough, R. W.; Yamamoto, Y. (eds.). Huntsville, AL; University of Alabama (1972). 797p. (CONF-720812-).

From second US-Japan conference on matrix methods of structural analysis; Berkeley, California, USA (14 Aug 1972).

A separate abstract was prepared for 3 of the 38 papers presented. The remaining 35 papers were not within the subject scope of NSA. (TFD)

For abstracts of individual papers see: 10811-10813.

10811 FINITE ELEMENT CONTRIBUTION TO FRACTURE MECHANICS. Hartz, B. J. (Univ. of Washington, Seattle); Chopra, P. S. pp 457-471 of Advances in Computational Methods in Structural Mechanics and Design. Oden, J. T. (ed.). Huntsville, AL; Univ. of Alabama (1972).

From second US-Japan conference on matrix methods of structural analysis; Berkeley, California, USA (14 Aug 1972). See CONF-720812-.

The finite element method is used to investigate the problem of branch and secondary crack formation and multiple fracture. This is investigated by solving sequences of incrementally related boundary value problems and evaluating strain energy release rates associated with incrementing flaw-initiated and branching cracks as functions of the parameters defining material flaw sizes, orientations and locations, branching configurations, and the primary crack. Release rates are evaluated, following Watwood, by direct calculation of strain energies associated with finite element solutions of the sequential boundary value problems. Probabilities of branching and secondary crack formation are associated with the strain energy release rates. Whereas earlier work by Hartz and Chopra considered only symmetrical branching and flaw configurations, some results are now presented for the more probable non-symmetric cases. (auth)

10812 PRACTICAL ANALYSIS OF STEEL STRUCTURES USING HIGHER ORDER ELEMENTS. Nakao, Y. (Hiroshima Technical Inst.); Kawashima, M. pp 573-589 of Advances in Computational Methods in Structural Mechanics and Design. Oden, J. T. (ed.). Huntsville, AL; Univ. of Alabama (1972).

From second US-Japan conference on matrix methods of structural analysis; Berkeley, California, USA (14 Aug 1972). See CONF-720812-.

A practical analysis of steel structures using cubic interpolating functions with parameters of nodal displacements and their derivatives is described, and the method to decrease the number of unknown parameters is proposed by imposing approximate restraining conditions on unknown parameters. Extension of this method to natural vibration analysis is also explained. Finally, application examples of this method to actual structures are shown. (auth)

10813 APPLICATIONS OF FINITE ELEMENT ANALYSIS. Gallagher, R. H. (Cornell Univ., Ithaca, NY). pp 641-678 of Advances in Computational Methods in Structural Mechanics and Design. Oden, J. T. (ed.). Huntsville, AL; Univ. of Alabama (1972).

From second US-Japan conference on matrix methods of structural analysis; Berkeley, California, USA (14 Aug 1972). See CONF-720812-.

Finite element analysis of nuclear reactor structures has assumed major importance because of the emphasis placed by certifying agencies on highly accurate analyses of all design components. Two types of structural forms are predominant, shells and solids, and for each of these the phenomena of interest include thermal stresses, plasticity, creep, and fracture mechanics. This review first examines applications of shell and solid elements, respectively, with emphasis on the scale of analysis and the choices made between alternative types of available element formulations. Published applications experience in thermal stress is then reviewed, including the related matter of thermal (heat conduction) analysis. Likewise, published descriptions of inelastic analysis are identified and the scale of these in both size of representation and time or load-increment history is treated, as are the types of constitutive relationships employed. Applications reviewed are pertinent to a range of problems well beyond those encountered in nuclear reactor structural design. (auth)

Nuclear Explosions

Refer also to abstract 10881.

10814 (AD-733195) SAAC EVALUATION OF THE SAAC/LASA SYSTEM. Dean, W. C.; Ahner, R. O.; Chiburis, E. F. (Teledyne Geotech, Alexandria, Va. (USA)). Aug 1971. Contract F33657-71-C-0510. 103p. NTIS.

The report is an evaluation of the SAAC/LASA system known as the integrated Seismic Research Signal Processing System which was programmed by IBM. The system operates in two parts. The Detection Processor performs data acquisition and signal detection. The Event Processor is designed to recognize true signals and false alarms and to extract event parameters, refine locations, and publish an earthquake bulletin. The Event Processor is programmed to work either in an automated mode in which the computer analyzes events and publishes the bulletin without help from a seismic analyst, or to act as an aide to the analyst who can edit the event processing on a display console. The Detection Processor works well as a data acquisition, recording, and signal detection system. The Event Processor with analyst editing is able to handle the data output from LASA and produce an acceptable seismic bulletin within 24 h. (auth)

10815 (AD-737125) COMPARATIVE STUDY OF THE ELASTIC WAVE RADIATION FROM EARTHQUAKES AND UNDERGROUND EARTHQUAKES AND UNDERGROUND EX-

PLOSIONS. Lambert, D. G.; Flinn, E. A.; Archambeau, C. B. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 27 Oct 1971. Contract F33657-72-C-0009. 90p. (SDL-284). NTIS.

A detailed analysis of the surface wave radiation from two underground explosions (BILBY and SHOAL) and an earthquake (near Fallon, Nevada) whose epicenter is only 60 km from SHOAL indicates that: at long periods the surface wave radiation from the earthquake can be explained by a pure quadrupole (double-couple) source, but at higher frequencies the radiation pattern shows asymmetries which suggest effects due to rupture propagation which require higher-order multipole terms in the source equivalent representation; the surface waves from the explosions can be explained by superposed monopole and quadrupole sources, with no indication of higher-order multipole terms; a principal conclusion of the study is that the anomalous radiation from explosions is due to stress relaxation around the shock-generated shatter zone and not due to earthquake triggering. (auth)

10816 (AD-737129) AUTOMATIC NETWORK DETECTION. Wirth, M. H.; Blandford, R. R.; Shumway, R. H. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 9 Dec 1971. Contract F33657-72-C-0009. 78p. (SDL-285). NTIS.

The theory of automatic detection at a seismic array by means of an F statistic is extended to a network of such arrays. The arrays may have equal or different expected signal-to-noise ratios. Two techniques are discussed: the composite F detector in which a vote is taken among the arrays; a multi-array F detector in which the original data from the independent arrays are combined to form one F statistic. (auth)

10817 (AD-739178) GENERALIZED LINEAR FILTERING OF SEISMIC-ARRAY DATA. Lintz, P. R.; Sax, R. L.; Blandford, R. R. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 8 Oct 1971. Contract F33657-70-C-0941. 87p. (SDL-269). NTIS.

The theory of generalized linear filtering (Oppenheim, 1966, 1969) is applied to the problem of averaging the transfer functions between a seismic source and seismic recording stations on a continental-sized array. To provide synthetic data for a test of the processor, a simple source signal is passed through nine different random perturbations of a velocity-depth structure yielding nine different synthetic seismograms. Two nuclear explosions (LONGSHOT and MILROW) and an Andreanoff Islands event (22 November 1965) are also processed. The earthquake appears to have longer time terms remaining after generalized linear filtering and the nuclear events appear more similar (before the arrival of the depth phase). (auth)

10818 (AD-740424) EMPIRICAL MATCH-FILTER STUDY WITH CENTRAL ASIAN AND SOUTH PACIFIC EVENTS. Von Seggern, D. H. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 30 Jun 1971. Contract F33657-70-C-0941. 55p. (SDL-270). NTIS.

Two suites of events, one in the Tonga Islands and the other in the Hindu Kush, were match filtered to determine relative enhancement in signal-to-noise ratio achieved by various procedures. It was found that match-filter S/N enhancement depends very little on the proximity of the reference event used as a match filter for distances as great as 600 km. For both regions, one event with high S/N ratio performed as well as many closer events in match filtering. Pre-whitening the real signals from zero to the folding frequency before using them as matched filters resulted in serious S/N decreases on the output unless band-pass filtering was applied simultaneously to the signal band, approximately 15 to 50 s. A linear chirp waveform worked as well as a real waveform for the Asian events, but it was inferior to real waveforms in the Pacific. (auth) (GRA)

10819 (AD-740426) RADIATION OF RAYLEIGH WAVE ENERGY FROM NUCLEAR EXPLOSIONS AND EARTHQUAKES IN SOUTHERN NEVADA. Masse, R. P. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 30 Mar 1971. Contract F33657-70-C-0941. 117p. (SDL-266). NTIS.

Amplitudes of Rayleigh waves generated by some southern Nevada nuclear explosions and cavity collapses were analyzed. The Rayleigh amplitude radiation patterns for all the explosions and collapses investigated were found to be similar within the expected variation of 30% due to calibration and measurement errors. The primary factor affecting the Rayleigh amplitude radiation patterns of the explosions was found to be the effect of the earth structure along the travel paths from source to receivers, with the effect of any tectonic strain release being small. (auth)

10820 (AD-740427) SINGLE STATION AND ARRAY METHODS FOR IMPROVED SURFACE WAVE SPECTRAL ESTIMATES. Lambert, J. W.; Alexander, S. S. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 13 Dec 1971. Contract F33657-72-C-0009. 106p. (SDL-264). NTIS.

Combined matched filtering and array summing methods have been developed that yield improved spectral estimates for weak surface waves. Both theoretically and experimentally the best spectral estimates are obtained by first beaming an array of individual matched filtered seismograms and then computing a single noise-corrected spectrum. Spectral results for test cases and actual events are compared using three different techniques. Computer programs implementing these spectral methods have been written which are suitable for routinely processing many events. (auth) (GRA)

10821 (AD-743072) ANALYSIS OF TELESEISMIC DATA FOR THE NUCLEAR EXPLOSION MILROW. Von Seggern, D. H.; Lambert, D. G. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 13 Apr 1972. Contract F33657-72-C-0009. 148p. (SDL-258). NTIS.

MILROW, the second United States underground nuclear explosion on Amchitka Island, was an order of magnitude larger than LONG SHOT, the first test there. Magnitude-yield scaling between the two for both surface waves and body waves followed theoretical predictions well and agreed with Nevada Test Site (NTS) scaling. A computed location of MILROW using LONG SHOT traveltime anomalies was only 1.2 km in error horizontally and 11.8 km vertically, a substantial improvement over a location using no anomalies. The presence of direct shear waves and Love waves for MILROW can be attributed to causes other than tectonic strain release, such as mode conversion, crack formation, and structural features of the surrounding medium. The detection of Love waves from LONG SHOT and the MILROW cavity collapse were important results bearing on the determination of the shear-generating mechanism. All the common identification criteria were applied to MILROW and its collapse: location and depth, M(s) vs m(b), spectral ratios, complexity, shear-wave excitation, and radiation patterns. MILROW appeared to be typical of explosions while, in contrast, the collapse was much like an earthquake. (auth)

10822 (AD-745874) SAAC (LARGE APERTURE SEISMIC ARRAY) EQUIPMENT AND SOFTWARE PERFORMANCE. McCoy, E. B. (Teledyne Geotech, Alexandria, Va. (USA)). 16 Jun 1972. Contract F33657-71-C-0510. 59p. (SAAC-TR-7). NTIS.

The performance of the equipment and software of the SAAC (LASA) system is presented. The system operates in two parts. The Detection Processor performs data acquisition and signal detection. The Event Processor selects detections to process as events, refines locations and publishes an earthquake bulletin. The performance of both processors was high. The Detection Processor operated 97% of all available time throughout the second half of the year. The Event Processor report coverage was virtually the same as DP recording coverage throughout most of the year. (auth)

10823 (AD-746666) LONG-RANGE SEISMIC MEASUREMENTS. Final Report, January 1970–October 1971. (Teledyne Geotech, Garland, Tex. (USA)). 23 May 1972. Contract F33657-70-C-0646. 216p. NTIS.

The progress of the Long-Range Seismic Measurements (LRSM) Program during the period 1 January 1970 through 31 October 1971 is described. At the beginning of the report period, there were seven mobile observatories and eleven portable seismograph systems in the LRSM program. These seismograph systems participated in related programs and experiments such as MIRACLE PLAY–HUMID WATER, HANDLEY, and CANNIKIN. Six portable strain systems were operated at the Nevada Test Site. Several special studies were conducted—deep hole, long-period instrumentation evaluation; long-period noise study at Fairbanks, Alaska; atmospherically-generated seismic noise study at Grand Saline, Texas, and Willis Point, Texas. (auth)

10824 (AD-747762) APPLICATION OF RAY-TRACING TO SEISMIC EVENT LOCATION. Page, E. A. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 3 Jul 1972. Contract F33657-72-C-0009. 49p. (SDL-293). NTIS.

The objective of the study was to determine whether source modeling could improve teleseismic event locations near island arc structures, using models defined by available information about the underthrusting plates of these regions. A location method based on ray-tracing, using a crude source region plate model is described. In the case of the Aleutian-Alaskan region, this method predicts that all teleseismic locations should be shifted along the perpendicular to the Aleutian arc near the source location. The magnitude of the shift is estimated by a method which involves an initial hypocenter estimate, one calibration event anywhere along the island arc, and ray-tracing calculations of time residuals for sources near the estimated

hypocenter. The conclusion is that the technique shows promise of being able to remove location bias in island arc structures and should be investigated further. (auth)

10825 (AD-747763) SEISMIC SHEAR WAVES AS A DISCRIMINANT BETWEEN EARTHQUAKES AND UNDERGROUND NUCLEAR EXPLOSIONS. von Seggern, D. H. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 5 Jul 1972. Contract F33657-72-C-0009. 25p. (SDL-295). NTIS.

The theoretical amplitude ratio of shear waves to compressional waves is computed using point double-couple representations of earthquakes. These ratios are compared to earthquake data from the LRSM and VELA observatory network. The earthquake data on shear-to-compressional ratios from this network is directly compared to that from NTS underground nuclear explosions. The shear-to-compressional ratio in the teleseismic distance range is found to be significantly greater for earthquakes than explosions, especially in the short-period band. However, use of shear wave data to discriminate between earthquakes and explosions is hampered by a high detection threshold. (auth)

10826 (AD-747764) DETECTION AND ANALYSIS OF MULTIPLE SEISMIC EVENTS. Flinn, E. A.; Cohen, T. J.; McCowan, D. W. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 22 Jun 1973. Contract F33657-72-C-0009. 51p. (SDL-297). NTIS.

Several methods of analyzing short-period seismic records to detect multiple events were tested. The data were from a pair of chemical explosions at a dam site near Alma Ata, recorded at the Mould Bay, Canada, seismic observatory. The methods evaluated included visual analysis of array beams, multichannel matched filtering, autocorrelation analysis, and cepstral analysis. For matched filtering the seismogram waveforms were used from a seismic event which occurred reasonably close to the Alma Ata site. Measurements using the spectra or the cepstra appear to be more accurate in determining the delay time between the two events. The analysis methods discussed are generally in good agreement with the announced time between the explosions, and their yield ratio. (auth)

10827 (AD-750541) RAYLEIGH WAVE AND ACOUSTIC-GRAVITY WAVE SIGNALS FROM NUCLEAR EXPLOSIONS IN THE ATMOSPHERE. Final Technical Report, 1 March 1969-31 March 1972. Newton, C. A. (Teledyne Geotech, Alexandria, Va. (USA)). 31 Aug 1972. 26p. (AFOSR-TR-72-2011). NTIS.

The detection of nuclear explosions in the atmosphere has posed problems to the variety of techniques used to sense the resulting disturbances. Hence, the research covered by the subject contract was directed toward the extraction of intelligence from microbarographic signals. The principal objective was to improve the ability to determine the yield and height of burst of nuclear explosions in the atmosphere. Necessarily there were two related, intermediate objectives: namely, to develop digital data processing techniques for detecting and analyzing signals recorded by microbarograph arrays, and to improve predictions of spectra and waveforms of acoustic-gravity waves as well as of their associated seismic surface waves. (auth)

10828 (AD-750779) SEISMIC ARRAY ANALYSIS CENTER. Quarterly Technical Summary Report, April-June 1972. Mack, H. (Teledyne Geotech, Alexandria, Va. (USA)). 25 Jul 1972. Contract F33657-72-C-0471. 10p. NTIS.

The report summarizes the operations and accomplishments in the Seismic Array Analysis Center for the period of April, May and June 1972. (auth)

10829 (AD-750781) SPECTRAL WHITENING WITH APPLICATION TO EXPLOSION PP. Cohen, T. J.; Sax, R. L.; Husted, H. L. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 12 Jan 1972. Contract F33657-72-C-0009. 80p. (SDL-282). NTIS.

A method is proposed for whitening the spectra of teleseismic P waves to aid in the determination of event depths. The method uses a network of common recording stations, all of which must have recorded signals from a suite of closely-spaced events, e.g., a set of underground explosions. Individual spectra are whitened by removing a path-recording site response determined by averaging spectra from the suite of events as recorded at a single station. The whitened spectra from a single event are then summed over the recording network to yield a whitened source spectra. The whitening process enhances spectra components in the band 2 to 5 Hz. (auth) (NTIS)

10830 (AD-751243) QUARTERLY TECHNICAL SUMMARY REPORT, JULY-SEPTEMBER 1972. Blandford, R. R. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 18 Oct 1972. Contract F33657-72-C-0009. 12p. NTIS.

The report summarizes the work done by the SDL during the period July through September 1972, and primarily concerns the seismic research activities related to the detection and identification of nuclear explosions and earthquakes. The report also contains brief discussions of the support tasks and data services which were performed for other government contractors and for participants in the VELA-UNIFORM and PRIME ARGUS projects. (auth)

10831 (AD-752161) SEISMIC ARRAY ANALYSIS CENTER. Quarterly Technical Summary Report, July-September 1972. Mack, H. (Teledyne Geotech, Alexandria, Va. (USA)). 18 Oct 1972. Contract F33657-72-C-0471. 10p. NTIS.

The report summarizes the operations and accomplishments in the SAAC for the period of July, August and September 1972. Tasks performed include the following: Operate SAAC; Evaluation; LASA/NORSAR comparison; and, LP network evaluation. (auth)

10832 (AD-754212) STUDY OF NUMERICAL METHODS IN SEISMIC PROBLEMS. McCowan, D. W.; Newton, C. A.; Page, E. A.; Peterson, A. F.; Flinn, E. A. (Teledyne Geotech, Alexandria, Va. (USA)). 7 Sep 1972. Contract F44620-69-C-0082. 61p. (AI-72-2). NTIS.

The application of two numerical methods (finite-element and finite difference approximations) toward the ultimate solution of problems involving the propagation of Rayleigh waves generated by an explosion in the atmosphere over an island atoll was investigated. Because of mathematical difficulties in these methods, useful calculations of Rayleigh wave spectra at teleseismic distances were not obtained. It appears that the physical constraints of the atoll structure, e.g., abrupt changes in elastic properties in both lateral and vertical directions, require either the application of large and costly computer codes or an advance in the present state of the art in numerical simulation. Examples are offered of numerical solutions to problems which have known analytical solutions. (auth) (NTIS)

10833 (AD-871959) LONG-PERIOD SEISMIC NOISE AND ATMOSPHERIC PRESSURE VARIATIONS. Sorrells, G. G.; Der, Z. (Teledyne Geotech, Garland, Tex. (USA)). 1970. Contract F33657-69-C-0757. 75p. NTIS.

Preliminary studies of the long-period seismic noise and the atmospheric pressure fields were made at the Kleer Mine near Grand Saline, Texas, during the winter of 1968. The results of the studies indicate that during periods of atmospheric turbulence the vertical and horizontal components of the seismic noise field observed at the surface may increase in total power by as much as 16 and 34 db within the period range from 20 to 60 s. (auth)

10834 (CONF-730629-2) DAMAGE PREDICTION FOR LOW-RISE BUILDINGS. Blume, J. A.; Scholl, R. E. (Blume (John A.) and Associates, Engineers, San Francisco, Calif.). 1972. 4p. Dep. NTIS $3.00.

From 5th world conference of earthquake engineering; Rome, Italy (25 Jun 1973).

Experimentally obtained low-rise building research findings applicable to two distinct procedures for predicting damage from ground motion are described. Three types of studies were conducted: (1) vibration tests of real buildings; (2) laboratory tests of structure elements; and (3) analysis of motion and damage data obtained from actual ground motion situations. The two prediction methodologies are: (1) a mass-spring modeling procedure wherein response is calculated and appropriate structure-element damage criteria are used to predict damage; and (2) a more direct procedure that involves the development of ground motion-damage relationships. The experimental findings are used in the two methodologies to compare their respective damage predictions. Conclusions are that the predictions compare well enough such that confidence in both procedures is enhanced. (auth)

10835 (CONF-730629-4) STRUCTURAL RESPONSE TO MAN-INDUCED GROUND MOTION. Blume, J. A.; Freeman, S. A. (Blume (John A.) and Associates, Engineers, San Francisco, Calif.). 1972. 4p. Dep. NTIS $3.00.

From 5th world conference of earthquake engineering; Rome, Italy (25 Jun 1973).

The structural response program for the seismic safety aspects of United States underground nuclear detonations has been producing, as a by-product, information and various procedures potentially useful with natural earthquakes. Information and references available from this work are outlined. (auth)

10836 (LA-UR-73-713) EFFECTS OF TURBULENCE ON LOW ALTITUDE FIREBALLS AT LATE TIMES. Ruppel, H. M.; Gentry, R. A. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 17p. (CONF-730442-4). Dep. NTIS $3.00.

A discussion of the effects of turbulence on the dynamics of fireballs with a review of the turbulence model currently in use at Los Alamos is presented. (TFD)

10837 (PNE-RB-38) PROJECT RIO BLANCO. A Government-industry Natural Gas Production Stimulation Experiment Using Nuclear Explosives. (Project Rio Blanco Joint Office of Information (USA); CER Geonuclear Corp., Las Vegas, Nev.). 1 Mar 1973. 24p. Dep. NTIS $3.25.

Topics discussed include goals, participants, history, environmental statement, experiment design, future plans for the area, safety program, insurance and claims adjustment, and other safety agencies and contractors. (TFD)

10838 (TID-26320) STATISTICAL CORRELATION OF OBSERVED GROUND MOTION WITH LOW-RISE BUILDING DAMAGE. Scholl, R. E.; Farhoomand, I. (Blume (John A.) and Associates, Engineers, Las Vegas, Nev. (USA)). 1973. 39p. Dep. NTIS $4.00.

A statistical study was conducted correlating ground motion with structure damage data from the RULISON underground nuclear explosion gas stimulation experiment. The statistical study first leads to the identification of the ground motion characterization that best represents the damage potential of ground motion; then to the development of motion–damage relationships for low-rise buildings subjected to ground motion. The motion–damage relationships are derived both for overall damage as well as for the most frequently damaged building components. The overall motion–damage relationships are given in terms of incidence of complaints (complaint ratio), incidence of damage (damage ratio), and damage cost (damage cost factor). (auth)

10839 (UCID-15759) TRANSIENT GAS FLOW IN A POROUS COLUMN. Morrison, F. A. Jr. (California Univ., Livermore. Lawrence Radiation Lab.). 23 Sep 1970. 90p. Dep. NTIS $6.50.

Transient flow of an ideal gas in a porous cylinder is investigated analytically. The results may be applied to the flow of gas in the backfill following an underground nuclear explosion. Two models of the flow are proposed, isothermal flow and adiabatic flow. The isothermal model is the more realistic, but the adiabatic model serves to bound the effects caused by heat transfer. Calculations are made for a column of infinite length, a finite open column and a finite plugged column. The calculations for the infinite column are valid for flow in a finite column for a well defined period of time, significant compared to the duration time of high cavity pressure. Pressure distributions and mass flow rates are obtained. Comparison is made with experimental results. (auth)

10840 (USGS–474-142) HYDRAULIC TESTING AND SAMPLING OF WATER WELL NUMBER 2, PROJECT WAGON WHEEL, SUBLETTE COUNTY, WYOMING. Wagon Wheel-2. Dinwiddie, G. A. (Geological Survey, Lakewood, Colo. (USA)). Apr 1973. Contract AT(29-2)-474. 36p. (PNE-WW–27). Dep. NTIS $4.00.

Water Well No. 2 was drilled to obtain hydraulic data at the site of Project Wagon Wheel, a Plowshare Project in the Green River basin of Sublette County, Wyoming. Two intervals in the 5,200-ft deep hole were hydraulically tested and samples of water were obtained. Results of testing the upper interval, near the 2,300-ft level, indicate that transmissivity is about 9-m^3/d/m and that the static water level, after correction for density, is 99.4 ft below land surface. Examination of chemical analysis indicates that water from this upper interval is fresh. Results of testing the lower interval, near the 5,000-ft level, indicate that transmissivity is about 5.4 gpd/ft and that the static water level, after correction for density, is 56.4 ft below land surface. Examination of chemical analysis indicates that water from this lower interval is highly saline. Pressure head increases with depth in this hole, indicating the potential for upward movement of fluid. However, the great difference in chemical quality of fluid samples collected from the two tested intervals indicates that significant vertical movement of fluid upward is unlikely in the vicinity of Wagon Wheel Water Well No. 2. (auth)

10841 TRANS-CALIFORNIA SEISMIC PROFILE, DEATH VALLEY TO MONTEREY BAY. Carder, D. S. (Earthquake Mechanism Lab., San Francisco). Bull. Seismol. Soc. Amer.; 63: No. 2, 571-586(Apr 1973).

An experiment to investigate the major earth structure along a profile from the Nevada Test Site (NTS) to the Pacific Ocean across two sections of the Sierra Nevada, one in the Kings Canyon area and the other which includes Huntington Lake, was undertaken by the Earthquake Mechanism Laboratory of the National Oceanic and Atmospheric Administration (NOAA). Instrumental coverage included 35 temporary and seven permanent seismographs. Energy sources included four high-yield and 20 intermediate- to low-yield nuclear explosions under the NTS, one high-yield explosion under Amchitka Island of Alaska, two earthquakes near Santa Rosa, and one earthquake in Monterey Bay. An upper-mantle speed of 7.9 km/sec satisfied most of the observed data except under the Sierra where the velocity was somewhat lower than this. An earthquake in Monterey Bay helped to close the west end of the profile. The Sierra Nevada "root" in large part can be attributed to relatively low upper-mantle speed under the Sierras (estimated at 7.64 km/sec) which extends to an indefinite depth and which possibly may serve as lens to refract late arriving high-energy waves to coastal areas. Crustal thickness from the Sierra foothills eastward varies from 25 to 35 km, the thinner portion under the Sierra crest and Owens Valley, near Independence, and the thicker sections under the western Sierra and the basin ranges east of Owens Valley. West of Fresno, the crust thins more or less gradually to about 20 km in thickness under the western coast ranges. This profile contrasts with that from an earlier study, across the Central Valley south of Stockton, where no such thinning under the Central Valley was observed. The sub-Sierra crust east of Fresno is somewhat complicated. Low-angle thrusting toward the east is indicated. (auth)

10842 AMPLITUDE-YIELD SCALING FOR UNDERGROUND NUCLEAR EXPLOSIONS. Springer, D. L.; Hannon, W. J. (Univ. of California, Livermore). Bull. Seismol. Soc. Amer.; 63: No. 2, 477-500(Apr 1973).

About 60 sets of seismic amplitude-yield data were examined using standard regression techniques to determine slopes of amplitude-yield scaling relations for explosions in water-saturated tuffs and rhyolites. Both P-wave amplitudes and Rayleigh-wave amplitudes were studied at selected stations located at regional and teleseismic distances. The source population included only those underground nuclear explosions fired near or below the level of the static water table at Pahute Mesa, Nevada Test Site, and covered about three orders of magnitude in yield. Statistical tests applied to the slope parameter (b) indicate that the slopes at regional and teleseismic distances are different. An estimated mean value of b for P-wave amplitude/period (A/T) was slightly greater than 0.6 for regional distances but was almost 1.0 for teleseismic distances. The estimated mean value of b for Rayleigh-wave A/T data was about 1.1. At a given distance the slopes seem to be independent of the yield range considered for both P-waves and Rayleigh-waves. (auth)

Protective Structures and Equipment

10843 (PEL–225) TESTING ABSOLUTE AND ACTIVATED CHARCOAL FILTERS AT PELINDABA. Adrian, H. W. W.; Kruger, J. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Dec 1972. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

A general discussion is given of the use of and the need for particulate filters and gas absorbers at nuclear installations. Precautions to be taken on the installation of filters are given. The standard methods of testing absolute filters and gas absorbers are given. With a view to the simplicity of the test method and the purpose it should serve, an in situ leak-testing method by means of a condensation nucleus counter is suggested for particulate filters. Similarly, it is suggested that gas absorbers be tested with methyl iodide. The testing methods, the equipment and the procedures are described in some detail, including an elemental iodine test for gas absorbers. A testing rig is described, by means of which individual filters can be tested, if so required, or experiments be conducted on the behavior of filters. The main filter banks at the SAFARI-I Reactor building are briefly described. (auth)

Vacuum Engineering

Refer also to abstract 11176.

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstract 10653, 10889, and 10891.

10844 (NP-19774) GEOLOGICAL SURVEY RESEARCH, 1972. Chapter B. Geological Survey Professional Paper 800-B. (Department of the Interior, Washington, D. C. (USA)). 1972. 284p. GPO $2.25.

Separate abstracts were prepared for 6 of the 39 papers presented. The other papers discuss various geologic and hydrologic studies that are outside the subject scope of NSA. (ERB)

For abstracts of individual papers see: 10653, 10654, 10665, 10845, 10859, and 10884.

10845 (NP-19774, pp B67-B77) RECONNAISSANCE GEOLOGY AND MINERAL POTENTIAL OF THOMAS, KEG, AND DESERT CALDERAS, CENTRAL JUAB COUNTY, UTAH. Shawe, D. R. (Geological Survey, Denver). 1972.

In geological survey research, 1972.

Three recently recognized calderas in the Thomas Range, Keg Mountains, and Desert Mountain, central Juab County, Utah, offer exploration possibilities for undiscovered ore deposits. Three major episodes of volcanic activity in the region were (1) early (?) Tertiary eruption of intermediate-composition lavas and agglomerates; (2) middle Tertiary eruption of silicic ash-flow tuffs resulting in collapse of the three calderas; and (3) late Tertiary-Quaternary(?) eruption of basalt and alkali rhyolite. After caldera collapse, magmas invaded parts of the ring-fracture zones or resurgently domed the calderas. Mineralization that formed ore deposits peripheral to the Thomas caldera probably was nearly concurrent with eruption of the late alkali rhyolite. The ore deposits have yielded important amounts of manganese, fluorspar, uranium, and beryllium. Prospecting for deposits of these commodities is warranted where parts of the Thomas caldera rim, as well as of the Keg and Desert caldera rims, are covered by postmineralization surficial deposits. Deep exploration for base and precious metals may be justified beneath the manganese and fluorspar deposits. (auth)

10846 (PEL-227) PEGMATITE DEPOSITS IN THE REPUBLIC OF SOUTH AFRICA. Von Backstroem, J. W. (Atomic Energy Board, Pretoria (Union of South Africa)). Mar 1973. 31p. Dep. NTIS (U. S. Sales Only) $3.75.

Interest in pegmatites centers on minerals containing beryllium, lithium, bismuth, tantalum, niobium, and the rare-earths, which have proven or indicated usefulness in the development of nuclear power. Information concerning the occurrence, mode of emplacement, and source of the pegmatites, together with the modus operandi for their exploration, assessment of grades, and estimate of reserves are given. (auth)

10847 ADVANCES IN PROSPECTING FOR URANIUM. Hahn Weinheimer, P. (Technische Univ., Munich). Kerntechnik; 14: No. 6, 249-253(1972). (In German and English).

The prospecting for low grade uranium ores is necessary in order to provide the required raw material for the increasing nuclear energy generation. This calls for the use of specific geophysical prospecting methods with efficient appliances like gamma spectrometers, alpha detectors, and others, for measurement of radioactivity from the air, in the field and in the borehole. When geophysical measurements are impossible, geochemical analytical methods for traces of uranium in water of rivers and lakes, in plants and soil are applied. Trace elements can be an indication of the presence of uranium if satisfactory analytical methods are at hand. (GE)

10848 MINING AND PROCESSING OF URANIUM ORE. Siegers, A. (Urangesellschaft mbH und Co. KG, Frankfurt am Main). Kerntechnik; 14: No. 6, 254-260(1972). (In German and English).

Raw uranium ore as mined has a very low uranium content and must therefore be up-graded in an ore processing plant. This processing does not affect the isotopic composition of the uranium. The final processed product is called yellow cake and contains about 70% uranium in the form of uranium compounds. (GE)

10849 SREDNEI SODERZHANIYA ELEMENTOV-PRIMESEI V MINERALAKH. (Average Contents of Elemental Impurities in Minerals). Ivanov, V. V. Moscow; Izdatel'stvo Nedra (1973). 208p.

Data from a wide variety of sources were utilized in the compilation of this work on the distribution of elemental impurities in minerals. Eighteen sections of the book are devoted to as many minerals: sphalerite, molybdenite, bornite, antimonite, olivine, pyroxene, muscovite, etc., and the content of alkali metals, alkaline earths, etc. is tabulated throughout extensive tables. Of particular interest here is the inclusion of Th, and U in a few of the tables. (KSW)

10850 URAN I TORII V MAGMATICHESKIKH I METAMORFICHESKIKH PORODAKH TSENTRAL'NOI CHASTI ALTAE-SAYANSKOI SKLADCHATOI OBLASTI. (Uranium and Thorium Magmatic and Metamorphic Rock in the Central Part of the Altae-Sayan Folded Region). Mitropol'skii, A. S. (ed.). Transactions of the Institute of Geology and Geophysics, Issue 142. Moscow; Izdatel'stvo Nauka (1972). 224p.

Data are presented on the content, distribution, and form of occurrence of U and Th in intrusive, effusive, and metamorphic rocks of the central portion of the Altae-Sayan folded region. The behavior of radioactive elements in different endogenic processes is examined. The concentrations of U and Th are established as functions of the geological conditions of their deposition. The geochemical history of the radioactive elements is applied to problems of petrogenesis and ore formation. (198 references) (KSW)

Radioactive Effluents

Refer also to abstracts 11107 and 11362.

10851 (BNWL-1750(Pt.2), pp 6.12-6.13) FACTORS AFFECTING BIOGEOCHEMICAL CYCLING IN THE COLUMBIA RIVER. Robertson, D. E.; Silker, W. B.; Peterson, M. R. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

The most abundant radionuclides presently in Columbia River water and sediment are ^{58}Fe, ^{60}Co, $^{152-155}$Eu, ^{65}Zn, and ^{137}Cs. The river sediments remain a major repository for the Hanford origin radionuclides. River sediments were studied to determine the conditions under which radionuclides are released from the sediments to the river water, to seawater, or for assimilation by river organisms. Leaching of sediments with tap water removed very little radioactivity from river sediments, but seawater desorbed 40% of the ^{54}Mn and 15% of the ^{137}Cs and smaller amounts of ^{60}Co and ^{152}Eu. Within a few days sediments were leached with pH 2.3 hydrochloric acid to simulate the pH conditions in the gut of higher aquatic animals, and 75% of the ^{65}Zn, 56% of the ^{54}Mn, 26% of ^{60}Co, and lesser amounts of ^{46}Sc and ^{137}Cs were desorbed from the sediment. (CH)

10852 (BNWL-1750(Pt.2), pp 6.16-6.18) DECLINE OF RADIOACTIVITY IN BIOTA FOLLOWING SHUTDOWN OF HANFORD REACTORS. Cushing, C. E.; Watson, D. G. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

Data on the content of Hanford radioisotopes in the Columbia River for the sampling period June 1971 to June 1972 are summarized for ^{46}Sc, ^{54}Mn, ^{60}Co, ^{65}Zn, and ^{137}Cs. Because of the relatively high concentrations of ^{65}Zn in the biota, the seasonal fluctuations in the ^{65}Zn concentrations in plankton, periphyton, chironomid larvae, and suckers, a herbivorous fish species which feeds on periphyton, were studied. (CH)

10853 WATER'S EDGE: CRITICAL PROBLEMS OF THE COASTAL ZONE. Coastal Zone Workshop Held at Woods Hole, Massachusetts, May 22-June 3, 1972. Ketchum, B. H. (ed.). Cambridge, MA; Massachusetts Institute of Technology Press (1972). 411p. $3.95.

The book represents the professional judgement of the participants in the workshop on the problems created by man's use of coastal resources. The specific conclusions and recommendations of the workshop are summarized in Part I of the book. In Part II (6 chapters), constraints on man's activities are discussed under the following headings: living resources; nonrenewable resources; recreation and aesthetics; urbanization and industrial development; transportation and coastline modifications, and contamination and coastal pollution through waste disposal practices (including radioactive and thermal effluents). In Part III (5 chapters), management of coastal resources is discussed under the following headings: strategies and research needs for coastal zone management; allocating coastal resources; structure of management and planning; legal aspects of the coastal zone; and a systems view of coastal zone management. A general bibliography and author and subject indexes are included. (ERB)

Radioactivity Monitoring and Transport

Refer also to abstracts 10844, 10885, and 11844.

10854 (BNL-17874) 1972 ENVIRONMENTAL MONITORING REPORT. Hull, A. P. (comp.). (Brookhaven National Lab., Upton, N. Y.). May 1973. 53p. Dep. NTIS $4.75.

Natural background and radiation levels in the vicinity of Brookhaven National Laboratory attributable to its operations during 1972 are summarized. Among the data reported are external radiation levels; air particulate, tritium and radioiodine concentrations; precipitation and liquid effluent-related concentrations in stream, ground water, and surveillance wells, as well as in milk, grass, and soil samples. (ERB)

10855 (BNWL-1750(Pt.2), pp 2.2-2.4) PLUTONIUM STUDIES AT THE NEVADA TEST SITE. Gilbert, R. O.; Eberhardt, L. L. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

Methods used at the Nevada Test Site for sampling and analysis of soil and vegetation for ^{239}Pu and ^{240}Pu were evaluated in relation to the cost and accuracy of a hand held γ counter and wet chemistry laboratory techniques for estimations of Pu contamination. (CH)

10856 (BNWL-1750(Pt.2), pp 4.1-4.3) SAMPLING FOR RADIONUCLIDES AND OTHER TRACE SUBSTANCES. Eberhardt, L. L.; Thomas, J. M.; Gilbert, R. O. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

Much of the difficulty in determining whether a particular environmental crisis is real or not has to do with sampling. Until we understand the mechanisms and rates governing behavior of the chemical agents regarded as a threat to man and his living environment, there is no real assurance that a given substance is or is not a problem. Sampling methodology for dealing with contaminants and pollutants is discussed. It is pointed out that the processes of establishing baselines, useful monitoring schemes, appraising the threat to human health, and gaining a general understanding of ecological systems each add an increment of complexity to the sampling rationale. The value of mathematical models and statistical mechanics for handling data is discussed. (CH)

10857 (HASL-274) FALLOUT PROGRAM QUARTERLY SUMMARY REPORT, MARCH 1, 1973-JUNE 1, 1973. Hardy, E. P. Jr. (Health and Safety Lab. (AEC), New York). 1 Jul 1973. 196p. Dep. NTIS $7.60.

This report presents current data from the HASL Fallout Program; The Rocky Flats Division of Dow Chemical Company; The National Tsing Hua University in Taiwan; and the Radiological and Environmental Research Division at Argonne National Laboratory. The initial section consists of interpretive reports on the vertical migration of plutonium in soil and strontium-90 levels in human bone. Subsequent sections include tabulations of radionuclide levels in fallout, surface air, stratospheric air, milk, and tap water. A bibliography of recent publications related to radionuclide studies is also presented. (auth)

10858 (NERC-LV-539-23) ENVIRONMENTAL MONITORING REPORT FOR THE NEVADA TEST SITE AND OTHER TEST AREAS USED FOR UNDERGROUND NUCLEAR DETONATIONS, JANUARY-DECEMBER 1972. (National Environmental Research Center, Las Vegas, Nev. (USA)). May 1973. Contract AT(26-1) 539. 143p. Dep. NTIS $3.00.

During 1972, the monitoring of gamma radiation levels and concentrations of radioactivity in the environs of the NTS was continued through the use of off-site networks of radiation dosimeters and gamma-rate recorders, air samplers, and selected locations at which monthly samples of water and milk were collected for radiological analyses. The only radioactivity produced by nuclear tests at NTS and detected off-site was ^{133}Xe, which was observed in samples collected at stations of the Noble Gas and Tritium Sampling Network at Beatty, Diablo, and Hiko, Nevada. The levels of ^{133}Xe, which were attributed to gaseous seepage from underground tests, occurred only in a few samples and averaged over the period sampled during the year, were less than 0.04% of the Concentration Guide of the AEC Manual, Chapter 0524, for a population sample. All other increases in radioactivity concentrations observed in media collected around the NTS were attributed to seasonal variations in old atmospheric fallout and fallout from nuclear detonations by the People's Republic of China on January 7, 1972, and March 18, 1972. Radioactive noble gases were released during the Nuclear Furnace-1 test series and detected by aircraft sampling; however, no radioactivity was detected on the ground beyond the combined areas of the Nellis Air Force Range and the NTS. An estimate of the potential radiation exposure to off-site populations was determined to be less than 1% of the Radiation Protection Standards of the AEC Manual, Chapter 0524. The results of soil samples collected around the NTS and analyzed for plutonium content showed that ^{239}Pu is present outside the boundaries of the NTS at levels greater than would be expected from world-wide fallout ($\approx$1 nCi/m^2). A Long Term Hydrologic Monitoring Program was begun for off-NTS sites used previously for underground nuclear tests. These sites are located near Fallon, Nevada (Project Shoal), Central Nevada Test Area (Faultless Test), Grand Junction, Colorado (Project Rulison), Farmington, New Mexico (Project Gasbuggy), Carlsbad, New Mexico (Project Gnome), Hattiesburg, Mississippi (Projects Dribble/Miracle Play). Radioactivity concentrations will be checked in wells, springs, and surface waters which are down-gradient from ground waters at the project sites. All radioactivity concentrations in the samples collected during the year were at natural background levels with the exception of samples collected at USGS Wells Nos. 4 and 8 at the Project Gnome site and the HT-2M Well at the Project Dribble/Miracle Play site. The USGS wells at the Gnome site were used in a U. S. Geological Survey radioactive tracer study in 1963, at which time ^{137}Cs, ^{131}I, ^{90}Sr, and ^{3}H were injected into Well No. 8 and water was pumped out of Well No. 4. As a result, high levels of ^{3}H and ^{90}Sr were observed in samples collected from both wells while ^{137}Cs was detected only in the sample from Well No. 8. The highest concentration of radioactivity was for ^{90}Sr, which was 4.3 times its Concentration Guide of 3×10^{-7} μCi/ml for exposure to individuals. The HT-2M Well at the Dribble site was drilled about 200 feet from another well in which 338,000 gallons of radioactive waste was injected during CY 1965. During this report period, high levels of ^{3}H were detected in the well, the highest being 6.7×10^{-5} μCi/ml, which is 2.2% of the Concentration Guide for ^{3}H. The radioactivity concentrations of all other samples collected from wells near the contaminated wells were below the Concentration Guides and representative of normal background levels. All of the contaminated wells are fenced, locked, and posted to ensure that the wells are not used by unauthorized persons. The potential radiation dose equivalents received by off-site populations near the NTS and other locations referred to above were all estimated to be less than 1% of the Radiation Protection Standards of the AEC Manual, Chapter 0524. These estimates were based on actual measurements of gamma radiation levels at off-site populated locations and measurements of radioactivity concentrations in the pathways of exposure as close to off-site residents as possible, i. e., air, milk and water. (auth)

10859 (NP-19774, pp B265-B271) TRITIUM IN PINE TREES FROM SELECTED LOCATIONS IN THE UNITED STATES, INCLUDING AREAS NEAR NUCLEAR FACILITIES. Stewart, G. L. (Univ. of Massachusetts, Amherst); Wyerman, T. A.; Sherman, M.; Schneider, R. 1972.

In geological survey research, 1972.

Pine needles were sampled at several selected locations in the conterminous United States to determine if the natural tritium rainout pattern can be correlated with tritium in free water and in bound hydroxyls of new and old growth. Near nuclear facilities that are known to release tritium to the environment, the objective was to obtain some information on the distribution pattern and fate of tritium in nearby vegetation. Excluding samples near the nuclear facilities, the tritium concentrations in pine needles followed a geographic pattern similar to that for the rainout of bomb-produced tritium—a general increase with latitude and distance from the ocean. However, tritium concentrations were greater in plant tissue than would be expected from natural rainout. At the Savannah River Plant, South Carolina, the data clearly indicate a decreasing concentration of tritium with distance from the release areas. (auth)

Atmosphere

Refer also to abstract 12495.

10860 (HASL-274(App.)) FALLOUT PROGRAM QUARTERLY SUMMARY REPORT, MARCH 1, 1973-JUNE 1, 1973. (Health and Safety Lab. (AEC), New York). 1 Jul 1973. 440p. Dep. NTIS $10.00.

The following data are presented: ^{89}Sr and ^{90}Sr in monthly fallout deposition at selected world land sites; radionuclides and lead in surface air sampled at selected sites; and radiostrontium in milk and tap water in New York City. (ERB)

10861 (NIRS-RSD-34) RADIOACTIVITY SURVEY DATA IN JAPAN. (National Inst. of Radiological Sciences, Chiba (Japan)). Feb 1972. vp. NTIS (U.S. Sales Only).

Separate abstracts were prepared for seven papers included in these survey data. (ERB)

For abstracts of individual papers see: 10862-10865, 10873, 10878, and 11090.

10862 (NIRS-RSD-34, pp 13-14) DATA ON THE NUCLEAR TEST OF THE PEOPLE'S REPUBLIC OF CHINA. Gross Beta Radioactivity in Upper Air (12th). Feb 1972.

In radioactivity survey data in Japan.

Since 1960, Research and Development H.Q., Japan Defense Agency has measured the radioactivity of the radioactive debris in the lower level of the stratosphere and tropopause at regular intervals, using aircrafts with airborne dust samplers under the wing. Just after the 12th Nuclear Test of China, the special measurements were carried out over three areas of Japan. The gross beta-activity of each collected sample did not show any remarkable change, and was almost the same level as usual. Results obtained by the special measurements are shown in the table. (auth)

10863 (NIRS-RSD-34, pp 15-17) DATA ON THE NUCLEAR TEST OF THE PEOPLE'S REPUBLIC OF CHINA. Gross Beta Radioactivity in Rain and Dry Fallout (13th). Feb 1972.

In radioactivity survey data in Japan.

Daily rain and dry fallout samples were continuously from (9 a.m. to the next 9 a.m.) collected on the roof of the building of the National Institute of Radiological Sciences in Chiba city, to determine the gross beta-activity. Gross beta activity was measured with a Geiger–Mueller counter using the standard of uranium dioxide (U_3O_8). The radioactivity of the samples was measured at 6 hrs after sample collection. Results obtained during 8th to 14th, January 1972 are shown in the table. In the sample of the 10th to 14th, Jan., 1972 neptunium-239 and technetium-99m and other short lived radionuclides were detected by γ-ray spectroscopic method using NaI(Tl) and Ge(Li) detectors. The γ-ray spectrum of the sample are shown in the figure. Sampled milk at two stations in Chiba-city was analyzed concerning radioactive iodine. The result is shown in the table. Sampling locations of Chiba-city are shown. (auth)

10864 (NIRS-RSD-34, pp 18-19) DATA ON THE NUCLEAR TEST OF THE PEOPLE'S REPUBLIC OF CHINA. Gross Beta Radioactivity in Rain and Airborne Dust (13th). Feb 1972.

In radioactivity survey data in Japan.

A survey of gross beta-radioactivity in rain and airborne dust was conducted by using the data from 13 stations of the Japan Meteorological Agency. The procedures of sampling and counting are same as those previously described. The 13th nuclear test of the People's Republic of China was carried out on 7th January, 1972. It is believed that the test area is the neighborhood of Lake Lop Nor (40°N, 90°E), about 4000 km west-northwest of Tokyo. In Japan, abnormal microbarographic disturbances that are caused by the nuclear test were not observed, therefore the magnitude of this explosion may have been in the low energy range. The data of gross beta-radioactivity for the 8th to 14th January, 1972 are shown. The levels of radioactivity in rain showed some departure from those normal conditions at several stations during the period of the 12th to 14th. At Osaka, radioactivity in airborne dust showed a slight increase on the 13th. It is estimated from the air mass trajectory that the radioactive debris was emitted into the troposphere over Japan one day and a half after the explosion through an altitude of about 10 km (300mb level). (auth)

10865 (NIRS-RSD-34, pp 20-24) DATA ON THE NUCLEAR TEST OF THE PEOPLE'S REPUBLIC OF CHINA. Gross Beta Radioactivity in Rain and Airborne Dust (14th). Feb. 1972.

In radioactivity survey data in Japan.

The 14th nuclear test of the People's Republic of China was carried out on 18th March, 1972. It is believed that the test area is the neighborhood of Lake Lop Nor (40°N, 90°E), about 4000 km west-northwest of Tokyo. A slight abnormal microbarographic disturbance which was caused by the nuclear test was observed at several stations. It is estimated from the air mass trajectory that the radioactive debris was emitted into the troposphere over the northern part of Japan about 30 hours after the explosion through an altitude of about 10 km (300mb level). The data of gross beta-radioactivity for the 19th to 25th March, 1972 are shown. The radioactivity in rain did not show any departure from those normal conditions except the value of 3.2 pCi per cc that was observed at Sapporo on the 24th. At Osaka, radioactivity in airborne dust showed a slight increase on the 23rd. (auth)

10866 (NIRS-RSD-36) RADIOACTIVITY SURVEY DATA IN JAPAN. (National Inst. of Radiological Sciences, Chiba (Japan)). Aug 1972. 35p. Dep. NTIS (U.S. Sales Only) $3.75.

Data obtained as a result of routine radioactivity surveillance in Japan during 1971 and 1972 are presented. The meteorological data includes: concentration of radionuclides in airborne dust; ^{90}Sr and ^{137}Cs in airborne dusts, rain, and dry fallout; and monthly and cumulative deposits of ^{90}Sr and ^{137}Cs. The dietary data include: ^{90}Sr and ^{137}Cs in milk, powdered milk, rice, and tea; and ^{90}Sr in wheat. The human data consists of ^{90}Sr in human bone. All data are presented in tabular form. (ERB)

10867 (PEL-208) ENVIRONMENTAL RADIOACTIVITY AT THE NATIONAL NUCLEAR RESEARCH CENTRE, PELINDABA. Report for the Year 1971. Van As, D.; Vleggaar, C. M. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Dec 1972. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

A revised environmental survey program, with the emphasis on monitoring of the critical paths of exposure of the general public, was introduced during 1970. Results of determinations of both gross radioactivity and individual nuclides in samples of fish and water (which are critical materials for liquid effluent releases) from the Hartbeespoort Dam and from the Crocodile River, are given and discussed. Results of gamma-spectrometric, ^{131}I and ^{90}Sr analyses of milk, the critical material for releases to the atmosphere, are presented. Results are given of regular investigations of the composition of effluent releases. These investigations are performed in order to be able to detect other possible critical nuclides. Levels of deposited and airborne activity from nuclear bomb tests are reported. (auth)

10868 (PNE-WW-28) ENVIRONMENTAL MONITORING REPORT: PERIOD COVERING NOVEMBER 1, 1972–JANUARY 31, 1973. (Eberline Instrument Corp., Santa Fe, N. Mex. Dept. of Nuclear Sciences). 1973. 26p. Dep. NTIS $3.50.

For El Paso Natural Gas Co.

Beta radioactivity in air particulates ranged from 0.02 to 0.07 pCi/m^3. These levels are lower than for the previous quarter and indicate lower levels of worldwide fallout in the atmosphere. TLD data for the period November 22, 1972 to February 23, 1973, average 2.4 mrem/week. This is consistent with the previous quarter. Gross beta in surface, municipal, and well water ranged from less than 2 to 10 pCi/l. The tritium concentration, measured by gas counting, ranged from less than 0.06 to 0.61 pCi/ml in well water and from 0.61 to 1.29 pCi/ml in surface water. Gross beta in precipitation was 1.0 ± 0.1 nCi/m^2. The tritium concentration in air moisture was less than 1 pCi/ml. The concentration of ^{90}Sr in milk ranged from 3.5 pCi/l to 9.1 pCi/l. These concentrations were within the range of data reported by EPA. Tritium in milk was less than 1 pCi/ml. The concentration of ^{90}Sr in vegetation ranged from 0.56 to 1.36 pCi/g(dry weight). The tritium concentration was less than 1 pCi/ml of water recovered by distillation. Gamma emitters in deer, moose, elk, antelope, and sage grouse were below detectable levels, except for natural ^{40}K. The tritium concentration in elk from Half-Moon Mountain was 0.39 ± 0.04 pCi/ml of water recovered by distillation. The tritium concentration in antelope from the Pinedale area was 0.53 ± 0.04 pCi/ml of water recovered by distillation. Tritium in urine samples collected March 17, 1973, was less than 2 pCi/ml. None of the results obtained during the period differed significantly from expected levels. (auth)

10869 DETERMINATION OF THE FRACTION OF ACTIVITY EXISTING IN THE FORM OF UNATTACHED RaA IN THE ATMOSPHERE OF A URANIUM MINE. Chapuis, A. (Univ., Toulouse); Lopez, A.; Fontan, J.; Madelaine, G. J. Health Phys.; 25: No. 1, 59-65(Jul 1973). (In French).

The influence of different mining characteristics on the value of "f" (fraction of ultrafine particles of RaA unattached on condensation nuclei) was determined. Two different methods were used in the study for a number of different mining situations: theoretically for the values of "f" determined from equations of the radioactivity associated with ultrafine particles; and experimentally by in situ measurements of "f". (auth)

10870 EMISSION AND ATMOSPHERIC DISPERSION OF RADIOACTIVE FISSION PRODUCTS. Huebschmann, W. G. (Kernforschungszentrum, Karlsruhe, Ger.). Kerntechnik; 15: No. 2, 57-64(1973). (In German and English).

Radiation doses in the vicinity of a nuclear power plant, due to radioactive emissions from the plant, are determined by the emission rate, the dispersion factor, and the dose factor. The nature and the orders of magnitude of the first two factors are discussed with the aim of clarifying the calculation methods used for determining dose equivalents. The dose equivalents due to the most important radionuclides are estimated and are compared with the relevant permissible limits. Numerical examples show that the actual doses to be expected are far lower than these limits. (GE)

Soil

Refer also to abstract 11108.

10871 (UCRL-74424) ENVIRONMENTAL LEVELS OF RADIOACTIVITY IN LIVERMORE VALLEY SOILS. Lindeken, C. L.; Gudiksen, P. H.; Meadows, J. W.; Hamby, K. O.; Anspaugh, L. R. (California Univ., Livermore. Lawrence Livermore Lab.). 16 Apr 1973. 16p. (CONF-730603-3). Dep. NTIS $3.00.

From 18th Health Physics Society meeting; Miami Beach, Florida, USA (17 Jun 1973).

Soil samples collected from areas surrounding the Lawrence Livermore Laboratory in the Livermore Valley were analyzed for ^{239}Pu, ^{238}Pu, ^{241}Am, ^{90}Sr, ^{137}Cs, and naturally occurring gamma emitters as part of a continuing environmental surveillance program. The medium ^{239}Pu activity corresponds to a surface deposition value of 1.1 mCi/km^2. Activities from ^{238}Pu and ^{241}Am were lower than ^{239}Pu activity by a factor of about 10. Median ^{90}Sr and ^{137}Cs deposition values were 18 and 31 mCi/km^2, respectively. All deposition values appear to be typical of those expected from global fallout in this area. At present, ^{137}Cs is the principal γ emitter observed in fallout. The radiation exposure rate at 1 m, calculated from the median ^{137}Cs soil activity, was about 0.1 μR/hr. Natural terrestrial exposure rates calculated from the ^{40}K, ^{214}Bi, and ^{212}Pb soil sample activities vary from 3 to 7 μR/hr. These values are in good agreement with measurements made using CaF_2:Dy TLD dosimeters and those obtained with a field-operated Ge(Li) detector. (auth)

Water

Refer also to abstracts 10646, 10647, 10883, 10931, and 11092.

10872 (BNWL-1737) RADIOLOGICAL STATUS OF THE GROUNDWATER BENEATH THE HANFORD PROJECT, JANUARY–JUNE 1972. Kipp, K. L. Jr. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1973. Contract AT(45-1)-1830. 31p. Dep. NTIS $3.00.

The groundwater contamination pattern beneath Hanford at the present time can be divided into three source zones, based on the kinds and quantities of wastes disposed to ground at each location: 200 Areas (chemical processing areas) and associated 600 Area wells; 100 Areas production reactor areas) and associated 600 Area wells; 300 Area (fuel fabrication and laboratory area) and associated 600 Area wells. Groundwater concentration data for these three source zones during the first six months of 1972 are presented. An evaluation of ^{106}Ru–Rh and ^{3}H concentrations measured near the surface of the unconfined groundwater during the first half of 1972 showed that zones of detectable contamination extended in an easterly to south-easterly direction from 200-E Area, as has been observed in the past. Measurable tritium and nitrate ion concentrations were found along the Columbia River in the vicinity of the 100 Areas. A low groundwater mound showing uranium and nitrate ion continued to be observed in the 300 Area. A few locations for which average groundwater concentrations exceeded the Concentration Guide (CG) of 10 pCi/ml for ^{106}Ru–Rh were within either the 200-E or 200-W areas. Significant concentrations of ^{106}Ru (over 10% of CG) were found only in the 200 Areas. Gross beta activity concentrations in the groundwater beneath the 100 Areas were detectable only at 100-N Area from the normal effluent discharge to the 1301 crib. A concentration of ^{3}H that exceeded the Concentration Guide of 3000 pCi/ml (outside the area boundaries) was found in Well 699-35-70 (outside the south-east corner of 200-W Area) as has been noted previously. A moderate increase in tritium concentration levels and extent in the vicinity of 100 N area occurred during this report period due to processing of tritium bearing target elements. Nitrate ion concentrations greater than 10% of the Public Health Service (PHS) recommended drinking water standard of 45 ppm were observed in most groundwater samples from wells within and in the immediate vicinity of the 100-F, 200, and 300 Areas. However, groundwater from these zones is not consumed by humans or animals. Although water samples from several wells with piezometer tubes extending to deep aquifers were obtained and analyzed for tritium and nitrate during this report period, all samples had tritium concentrations less than the analytical limit of 1 pCi/ml and nitrate concentrations less than 1 ppm. (CH)

10873 (NIRS-RSD-34, pp 5-7) TRITIUM LEVEL OF RIVER SYSTEM AND COASTAL WATER IN JAPAN. Feb 1972.

In radioactivity survey data in Japan.

To determine the environmental tritium concentration in Japan, water samples of rivers, streams, ponds, and coast were collected in the vicinity of the nuclear power reactor in operation and under construction. The analyses were carried out by liquid scintillation counting using emulsion scintillator system after electrolytic enrichment. The data for the samples during one year from October 1970 to September 1971 are shown in the table. These results suggest that the tritium level in coastal water is laid on the range from 20 to 200 pCi per liter and in river system from 230 to 500 pCi per liter. (auth)

10874 DATA. Section II. Water. Radiat. Data Rep.; 14: No. 5, 289-297(May 1973).

Data are presented on the concentrations of alpha and beta sources and tritium in water samples collected from selected sites in California, Nevada, and Utah during November 1972. Data are also presented on the tritium concentration in tap water and surface water samples collected from selected sites in the United States on the Radiation Alert Network during October to December 1972. (ERB)

10875 TRITIUM BURDENS IN TWO ARCTIC VILLAGES. Eckert, J. A.; Evans, R. B. (National Environmental Research Center, Las Vegas, NV). Radiat. Data Rep.; 14: No. 5, 273-275 (May 1973).

During a routine visit to measure cesium-137 burdens in residents of two Alaskan villages, drinking water and urine samples were collected and subsequently analyzed for tritium by the National Environmental Research Center–Las Vegas. The mean concentrations at Noatak, Alaska, were 1,200 pCi/liter and 1,500 pCi/liter for tritium in drinking water and urine, respectively. At Kiana, the mean tritium concentration in drinking water was <400 pCi/liter, and the mean tritium concentration in urine was 1,000 pCi/liter. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 10852, 11088, 11089, 12501–12505, 12577, 12587, and 12589.

10876 (BNWL-1747) GAMMA AND LOGNORMAL DISTRIBUTIONS AS MODELS IN STUDYING FOOD-CHAIN KINETICS. Eberhardt, L. L.; Gilbert, R. O. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1973. Contract AT(45-1)-1830. 100p. Dep. NTIS $7.00.

The passage of trace substances through food-chains is of concern both in understanding biological productivity and in studying the dispersal and effects of contaminants such as DDT. The analysis of field data is largely dependent on much the same kinds of kinetic models as are used in assessing movement of tracers within a single organism. The choice of a suitable frequency distribution to represent observations of the concentration of substances such as radionuclides and DDT in samples of biota is discussed. Quite a variety of data on radionuclides indicates that the frequency distributions are markedly skewed, even in the face of efforts to limit analysis to data taken in relatively small areas and short time spans. Data on radionuclides (principally from fallout due to nuclear explosions) indicate the coefficient of variation to be frequently in the range of 10 to 40% and apparently constant over time for a given species and environment. Some data on concentrations of DDT in biota indicate that somewhat the same circumstances may obtain for pesticides. The usefulness of log-normal and gamma function distributions are discussed as appropriate models for frequency distributions of radionuclide concentrations in biota and substrates. Computer programs (LOGN for lognormal and SKEW for gamma) are included for use in calculating the coefficients of skewness and kurtosis from simulated data. It is concluded that it appears reasonably safe to neglect the differences between the lognormal and the gamma distributions for many practical purposes, and the simplest procedure for statistical analyses is just to use a logarithmic transformation and to proceed as though the data were thus normalized. (CH)

10877 (BNWL–1750(Pt.2), pp 6.7-6.8) FIXATION AND LONG TERM ACCUMULATION OF TRITIUM FROM TRITIATED WATER IN AN EXPERIMENTAL AQUATIC ENVIRONMENT. Strand, J. A.; Templeton, W. L. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

The accumulation of tritium from tritiated water in selected freshwater biota was studied in an experimental pond. Mussels, crayfish, carp, emergent plants and filamentous algae were maintained in a 30-foot diameter concrete lined pond. Tritium as tritiated water was introduced continuously for 8 months in the replacement water at a concentration of 1 μCi/liter, and the samples of water and biota were analyzed on a predetermined schedule, using combustion of samples for liquid scintillation counting. A rapid uptake of tritium during the first two days was demonstrated in all biota sampled. In mussel, crayfish, and carp, the concentration of body-water or volatile tritium approached 90 percent of the tritium in the pond water within two days of the introduction of the isotope, and remained at that level for the ensuing eight months of exposure. Emergent vegetation attained no more than 70% of the concentration of tritium in the pond water. In the filamentous algae, volatile tritium exceeded 90% of the pond concentration. The concentrations of the bound, or nonvolatile, tritium fractions varied with time and type of tissue. (CH)

10878 (NIRS-RSD-34, pp 1-4) EXTERNAL EXPOSURE DUE TO NATURAL RADIATION. Feb 1972.

In radioactivity survey data in Japan.

A field survey of exposure rates due to natural radiation was conducted throughout the Hokkaido district of Japan during June 1971. Distribution of observed locations in the district is indicated in the figure. In each location, from one to five sites containing at least five stations were made there. A total of 81 sites were measured. Observations were made using a spherical ionization chamber and several scintillation surveymeters. The spherical plastic ionization chamber of which inner diameter and wall thickness are respectively 200 mm and 3 mm (acrylate) has adequate sensitivity for field survey. The chamber was used as a standard of apparatus, but it is difficult to observe all locations only by the apparatus, so that a surveymeter with a NaI (Tl) $1''\phi \times 1''$ scintillator was used for regular measurements. Two types of surveymeters, the one with a $2''\phi \times 2''$ NaI(Tl) scintillator and the other with a $3''\phi \times 3''$ NaI(Tl) scintillator, were used as auxiliary devices. In 12 sites, both the chamber and the surveymeter were used for measurement of given stations and their readings are compared for drawing a relationship between them. Practically the direct reading of the survey-meter was reduced into the reading of the plastic chamber corresponding to it from the relationship of linear proportion. Systematic error at calibration (^{60}Co) and reading error (random) of the plastic chamber were respectively within ±6% (maximum overall error) and within ±3.5% (standard error for 6μ R/hr). Reading error of the survey-meter is about ±3% (standard error for 6μ R/hr). Measurements in an open bare field were made at one meter above the ground and outdoor gamma-ray exposure rates (μR/hr) were due to cosmic rays as well as terrestrial radiation, so that it may be considered that the contribution of fallout due to artificial origin was very slight. Gamma-ray exposure rates due to natural radiation in each location are shown, and population exposure due to natural radiation in each prefecture of the Hokkaido district is shown in the table. (auth)

10879 CONTAMINATION OF AGRICULTURAL PRODUCTS BY RADIOACTIVE MATERIALS, ESPECIALLY ^{90}Sr, ^{137}Cs, AND THEIR EFFECT ON THE HUMAN BODY. Bamdad, D. (Plant Pests and Diseases Research Inst., Teheran). Pahlavi Med. J.; No. 1: 51-58(1971).

A discussion is presented of the effects of atomic bomb explosions on radioactive contamination of foods. Contamination of foods with ^{137}Cs and ^{90}Sr is emphasized and pathological effects of these isotopes on the animal body are discussed. Contamination of cereals and cereal products in Germany with radioisotopes from fallout was studied and a table is presented to show ^{90}Sr content of wheat and rye during 1958 to 1963. Factors influencing the uptake of radioisotopes by various plant parts are discussed. Methods for measuring the ^{90}Sr content of food are discussed and a table of the ^{90}Sr content of various foods is presented. The maximum permissible dose of ^{90}Sr to the human body is discussed in relation to the calcium content of the skeleton. (HLW)

10880 DATA. Section I. Milk and Food. Radiat. Data Rep.; 14: No. 5, 277-288(May 1973).

The ^{90}Sr and ^{137}Cs concentrations in milk samples from the United States, Canada, Central and South America are reported for samples collected during January 1973. The average concentrations for the 12-month period ending in January 1973 is also given. The concentrations of ^{137}Cs, ^{89}Sr, ^{90}Sr, and tritium in milk samples from California, Nevada, and Utah are reported for samples collected by the Milk Surveillance Network during November 1972. (ERB)

10881 DATA. Section IV. Other Data. Radiat. Data Rep.; 14: No. 5, 313-331(May 1973).

The results of offsite surveillance activities around the Nevada Test Site during January to June, 1970 are presented. Results are also presented of on site surveillance activities at Argonne National Laboratory during January to December 1971. Seismic signals, presumably from a Soviet underground nuclear explosion, were recorded by the United States on April 19, 1973. The USAEC announced two underground nuclear tests in April 1973, one on April 25 and the other on April 26. (ERB)

10882 RADIOBIOLOGIYA I RADIOEKOLOGIYA SEL'SKOKHOEYAISTVENNYKH ZHIVOTNYKH. (Radiobiology and Radioecology of Domestic Animals). Annenkov, B. N. (ed.). Moscow; Atomizdat (1973). 224p.

The migration of the most important artificial radionuclides through the biological food chains is examined along with the metabolism of radionuclides in domestic animals and the effect of radiation and incorporated radionuclides in livestock. The successes of the broad range of experimental investigations are reviewed, both Russian and foreign. Apart from the theoretical interest, the data contains much of practical significance for lowering the uptake of radioactive substances in animal husbandry and livestock production. The book was written for radiobiologists, radioecologists, animal raisers, veterinarians, hygenists, and students of higher institutions of learning in animal husbandry and related fields. 107 tables, 33 figures, 395 references. (tr-auth)

Radiometric Techniques

Refer also to abstracts 10844 and 11844.

10883 (BNWL-1750(Pt.2), pp 3.7-3.8) PHYSICAL AND RADIOLOGICAL CHEMISTRY OF OCEAN SOLUTIONS. Silker, W. B.; Robertson, D. E.; Petersen, M. R. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

The rates and mechanisms of the chemical and mixing processes in the ocean were investigated by use of the oceanic distributions of ^{7}Be, fallout radionuclides, anthropogenic pollutants, and natural tracers. Increased areal coverage was afforded by the National Oceanic and Atmospheric Administration whose personnel conducted surface water sampling during scheduled cruises of the NOAA fleet. These studies provide increased understanding of the factors governing air-sea exchange processes and the subsequent diffusive and advective transport in the oceanic regime. (CH)

10884 (NP-19774, pp B191-B194) Rb-Sr AND FISSION TRACK AGE DETERMINATIONS IN THE PRECAMBRIAN PLUTONIC BASEMENT AROUND THE SUPERSTITION VOLCANIC FIELD, ARIZONA. Stuckless, J. S. (Northern Illinois Univ., De Kalb, IL); Naeser, C. W. 1972.

In geological survey research, 1972.

The plutonic rocks of the Precambrian basement around the Superstition volcanic field, Arizona, show the effects of three geologic events. The oldest is the emplacement of quartz diorite, and the second is the emplacement of granite (1,395 ± 45 m.y. by Rb-Sr mineral and whole-rock isochron and 1,390 ± 40 m.y. by fission-track age in sphene). The second event was intense enough to completely reset the fission-track age for sphene in the quartz diorite (1,390 ± 60 m.y.) and to disturb the Rb-Sr whole-rock isochron (1,540 ± 84 m.y.). The third event is related to cooling of the rock below 100°C after Laramide uplift and is indicated by a fission-track age in apatite of 50.1 ± 0.8 m.y. (auth)

10885 DATING RECENT RESERVOIR SEDIMENTS. Ritchie, J. C.; McHenry, J. R.; Gill, A. C. (Dept. of Agriculture, Oxford, MS). Limnol. Oceanogr.; 18: No. 2, 254-263(Mar 1973).

Radioactive fallout ^{137}Cs can be used to date sediment deposited in lakes and reservoirs since 1959. Within small regional watersheds, fallout ^{137}Cs is assumed to be uniformly distributed on the surface soil and is tightly adsorbed to surface soil particles. Some of these soil particles naturally labeled with ^{137}Cs then move through the sedimentation cycle and can be used to date sediment profiles. Two distinct periods of erosion and sedimentation (1959 to 1960 and 1963 to 1964) can be associated with periods of maximum atmospheric fallout. Data from other reservoirs illustrate the utility of this method. (auth)

10886 PATTERN RECOGNITION AS A MEANS OF FORMATION EVALUATION. Pickett, G. R. (Colorado School of Mines, Golden). pp A1-A21 of Transactions of the SPWLA Fourteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1973).

From 14th annual logging symposium; Lafayette, Louisiana, USA (6 May 1973). See CONF-730521-.

Techniques for interpretation of patterns obtained from the possible cross-plots of log responses are described. It is shown that the pattern recognition approach described here encompasses the more traditional interpretation methods (calculation of water saturation, Rwa, MOS, Rt/Rxo, Fr/Fs, etc.), while offering significant advantages over these methods. The basic advantage of the pattern recognition approach is that resistivity index (a measure of water saturation) can be derived without having a calibration for the porosity device (i.e., grain density, matrix Δt, etc.), without a knowledge of m, Rw, or Rmf, and in the presence of many types of logging calibration-type errors. The basic limitations are that a statistically significant number of zones are required and that unknown parameters (m, Rw, etc.) be reasonably constant for the zones used in the analysis. However, effects of changes or of presence of more than one value of a parameter or parameters can be predicted and accounted for. Under favorable conditions the patterns can be used to obtain values of m, matrix Δt and grain densities; rock types can be distinguished and calibration errors in the measurements can be detected and corrected. Uncertainties in the evaluation parameters (i.e., water saturation, resistivity index, etc.) can be estimated. It is concluded that pattern recognition is one of the most powerful interpretation approaches yet devised. Examples of the points discussed above are presented. (auth)

10887 FORMATION EVALUATION IN INDONESIA. Dadrian, C. (Schlumberger Technical Service, Paris); Brown, H.; Goetz, J.; Marchette, B. pp AA1-AA71 of Transactions of the SPWLA Fourteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1973).

From 14th annual logging symposium; Lafayette, Louisiana, USA (6 May 1973). See CONF-730521-.

The hydrocarbon-bearing reservoir rocks of Indonesia cover a wide range of lithologies and include clean carbonates and sandstones as well as formations of variable or very high clay content. Their evaluation is also sometimes complicated by the presence of impurities of volcanic origin. Many of the quantitative log-interpretation techniques developed in other areas of the world are applicable to the solution of Indonesian problems. However, in the very shaly reservoir formations sometimes encountered in Indonesia, existing methods for shaly formations require additional refinements in order to obtain reliable porosity, water-saturation, and lithology information. The wireline methods applied to formation evaluation in Indonesia today are discussed and the corresponding techniques with actual field examples are demonstrated. Topics considered are: the geology of Indonesia's oil basinal areas and the lithology of their sediments; examples of the use of logging techniques as an aid to the geologist; various aspects of formation evaluation through wireline methods of logging, sampling, and testing; and the use of all the outlined techniques in the complete evaluation of a typical Indonesian well. (auth)

10888 ALUMINUM ACTIVATION LOG. Scott, H. D.; Smith, M. P. (Texaco Inc., Bellaire, TX). pp F1-F26 of Transactions of the SPWLA Fourteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1973).

From 14th annual logging symposium; Lafayette, Louisiana, USA (6 May 1973). See CONF-730521-.

The possibility is discussed of using a measurement of the aluminum to provide the shale content of reservoir formations, since aluminum is a relatively constant component of shale. Using a ^{252}Cf neutron source emitting 10^9 neutrons/second, a continuous aluminum activation log was developed which can be operated at logging speeds of 20 feet per minute. The log has been run in one uncased and four cased wells. Results indicate that the log has good potential for determining the shale content of formations and should overcome the limitations of the natural gamma and S.P. logs mentioned previously. Neutron absorbers in the formations such as salt water and boron can affect the log but variations in these quantities can be corrected for if a log of Σ, the formation thermal neutron capture cross section, is available. Gamma rays in the range 1 to 2 MeV from the decay of ^{28}Al are used for the measurement. The use of ^{252}Cf as a neutron source instead of PuBe or AmBe is preferred in order to reduce the competing effect of silicon activation to a negligible level. (auth)

10889 INTERPRETATION OF GAMMA-RAY LOGS. Hallenburg, J. K. (Teton Exploration Drilling Co., Inc., Casper, WY). pp G1-G29 of Transactions of the SPWLA Fourteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1973).

From 14th annual logging symposium; Lafayette, Louisiana, USA (6 May 1973). See CONF-730521-.

The area under a γ-ray log curve is a function of the amount of radioactive material within the sensitive volume of the detector. The finite volume of detection results in bed boundary effects and multiple bed effects, which can be simplified for analysis. (auth)

10890 DEFINING INJECTION PROFILES USING THE NEUTRON LIFETIME LOG AND HIGH SIGMA FLUIDS. Matiisen, A. (Dresser Atlas, London). pp V1-V13 of Transactions of the SPWLA Fourteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1973).

From 14th annual logging symposium; Lafayette, Louisiana, USA (6 May 1973). See CONF-730521-.

Many different logging instruments are available for determining injectivity profiles. Spinner surveys measure fluid flow rate in casing. Tracer surveys have the ability to follow the injection fluid behind pipe. Temperature surveys indicate, through temperature anomalies, what happens in the formation. These logging methods are often combined in a multiple run survey to gather all the information available. The use of the Neutron Lifetime Log (registered service mark of Dresser Atlas, Petroleum Services Division, Dresser Industries, Inc.) and a high sigma fluid is suggested as an alternative to the above methods. This application of the NLL and the interpretation of three field examples are discussed. (auth)

10891 NEW THEORY, POSSIBILITIES, AND PRACTICE IN DIGITAL INTERPRETATION OF GAMMA-RAY LOGS. Czubek, J. A. (Inst. of Nuclear Physics, Krakow). pp W1-W22 of Transactions of the SPWLA Fourteenth Annual Logging Symposium. Houston, TX; Society of Professional Well Log Analysts, Inc. (1973).

From 14th annual logging symposium; Lafayette, Louisiana, USA (6 May 1973). See CONF-730521-.

The problem of the theory of digital interpretation of natural γ-ray logs is presented for three principal cases of measurement: the static one (point by point), the continuous one with a ratemeter, the continuous one with a digital record. Under the assumption that the borehole is perpendicular to the geological strata with a variable natural radioactivity, these three problems are described by the Fredholm integral equation of the first kind. At a given point z_i the solution is found in the form of the bounded series: $q(z_i) = \sum_{j=-p}^{+p} J(z_{i+j}) \cdot d_j(p)$; $p = 1, 2, \ldots, p$ where $q(z_i)$ is a concentration (or equivalent gamma-ray intensity in the layer of infinite thickness) of radioactive material, $J(z_{i+j})$ are the direct log deflections and the $d_j(p)$ coefficients, given in analytical form, take into account all borehole and measurement conditions. Examples of γ log interpretation using this method are given. Application of this method of interpretation is useful in uranium, oil and other minerals exploration when γ logging is used. (auth)

10892 WHOLE ROCK Th–Pb AGE FOR THE MASUKE AND DEMBE-DIVULA COMPLEXES, RHODESIA. Manton, W. I. (Univ. of Texas, Dallas). Earth and Planetary Science Letters; 19: No. 1, 83-89(May 1973).

A whole rock U–Th–Pb study was carried out on eight granites from a suite previously dated at 177 ± 4 my ($\lambda = 1.39 \times 10^{-11}$ yr^{-1}) by Rb–Sr methods. A U–Pb isochron was not obtained owing to recent leaching of U in the outcrop. Seven samples gave a Th–Pb isochron with age 184 ± 16 my ($\lambda = 4.99 \times 10^{-11}$ yr^{-1}), $(^{208}Pb/^{204}Pb)_0 = 39.2 \pm 0.2$ and MSWD 0.8. The eighth sample fell off the line and was rejected on geological grounds. Dissolving 5 g aliquots of the powdered rock markedly improved the reproducibility of U analyses but analysis of the variances suggests that inhomogeneities still might exist between duplicate dissolutions. Th–Pb geochronology needs further development to bring it to the level of precision of the Rb–Sr method. (auth)

10893 U–Th–Pb DATES ON ZIRCONS FROM THE EARLY PRECAMBRIAN AMITSOQ GNEISSES, GODTHAAB DISTRICT, WEST GREENLAND. Baadsgaard, H. (Univ. of Alberta, Canada). Earth and Planetary Science Letters; 19: No. 1, 22-28(May 1973).

A $^{207}Pb/^{235}U$ versus $^{206}Pb/^{238}U$ concordia plot for zircons from the Godthaab District Amîtsoq Gneisses yields a discordia line that intersects the concordia at 3650 ± 50 my. A similar plot of $^{208}Pb/^{232}Th$ versus $^{207}Pb/^{235}U$ gives a discordia line intersecting the concordia at 3648 ± 85 my. Neither Pb-diffusion loss models nor episodic Pb-loss models explain the relatively modest degree of discordance shown by these zircons. (auth)

Site Surveys

Refer also to abstracts 12253, 12289, 12381, 12404, 12419, 12426, 12433, 12446, and 12459.

10894 (DOCKET-701372-1) GULF YOUNGSVILLE NUCLEAR FACILITY. Environmental Impact Report. (NUS Corp., Rockville, MD (USA). Environmental Safeguards Div.). Feb 1973. 322p. (Gulf-EES-A-12380). Dep. NTIS $18.25.

A detailed statement by Gulf Oil Corporation on the environment impact of the construction and operation of the Gulf Youngsville Nuclear Facility, planned for the fabrication of cold fuel for High-Temperature Gas-Cooled Reactor power plants is presented. No significant adverse environmental impact will occur. The facility design incorporates effluent treatment systems which will reduce deleterious effluents to negligible quantities; i.e., the radiation doses to people at the site boundary are reduced to the "as low as practicable" levels specified in Title 10, Code of Federal Regulations, Part 50, Appendix I, and chemical releases are in compliance with Environmental Protection Agency (EPA) standards. Cooling towers are provided to reject waste heat to the atmosphere. Alternative process and waste treatment system designs were evaluated as an integral part of the effort to achieve substantial reductions in effluents released to the environment. Unavoidable adverse environmental effects are limited to the clearing of approximately 150 acres for fuel plant facilities. (auth)

10895 (LA–5129) PETROGRAPHY OF SOME ROCK TYPES OF THE PRECAMBRIAN BASEMENT NEAR THE LOS ALAMOS SCIENTIFIC LABORATORY GEOTHERMAL TEST SITE, JEMEZ MOUNTAINS, NEW MEXICO. Perkins, P. C. (Los Alamos Scientific Lab., N. Mex.). Jun 1973. Contract W-7405-eng-36. 12p. Dep. NTIS $3.00.

The proposed geothermal energy experiment by the Los Alamos

Scientific Laboratory is to be conducted in Precambrian rocks underlying the Jemez Plateau, New Mexico. This study describes 25 samples from 152 ft of drill core taken from Granite Test Hole One, and 12 examples of Precambrian rocks of the region not far distant from the proposed geothermal test site. The upper 94 ft of Precambrian rock in the test hole is granite and granodiorite, partly gneissic in texture. The lower 61 ft is biotite-amphibolite veined by tonalite-aplite. All cracks observed in thin section follow thin calcite veins. In hand specimen, chlorite-lined fracture surfaces are also present. Rocks of the drill core provide a good variety of compositions representative of many of the rock types collected for this study from regional localities (Sandia Mountains, San Pedro Mountain, Soda Dam, Guadalupe Box, and the Nacimiento Mountains). As fresh samples, they will provide suitable material for hydrothermal experiments. The presence of "red granite" xenoliths in pyroclastic rocks of the Jemez Plateau, and the predominance of granitoid rocks over amphibolite in regional outcrops suggest that granitic rocks are the predominant rock type below the test site. (auth)

Thermal Effluents

Refer also to abstracts 10853 and 12147.

10896 (BNWL-1750(Pt.2), pp 1.1-1.4) ENVIRONMENTAL IMPACT STATEMENTS. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

The Ecosystems Department, along with other Departments of Battelle, Pacific Northwest Laboratory, has for the past year been assisting the Directorate of Licensing in the preparation of environmental statements for nuclear power stations. These statements are addressed to the assessment of impact potentially arising from both siting and operation of the nuclear stations. During the 1971 calendar year, most stations that were evaluated were in some stage of completion. In some instances, they had been operating for one or more years. Most nuclear power stations are using, or plan to use, once-through cooling. Consequently, aquatic ecosystems are subject to the greatest potential impact from thermal and chemical effluents. The stations also are located over a wide geographic range, with differing climatic zones. Many different surface waters are used for cooling, however, potential impact on the aquatic life is general and common to many stations. Such impact includes the entrapment of small aquatic organisms on the condenser cooling water intake screens; their passage through the condensers, where an abrupt and substantial rise in temperature occurs; their exposure to high temperatures in the discharge structures; the effects of above ambient temperatures on organisms in the mixing zone; their exposure to cold-shock during periods of plant shut-down during winter conditions; and their exposure to biocides and other chemicals discharged from the plant. The extent of impact may depend significantly on both hydrological characteristics and water quality status of the body of water used for cooling. Data obtained at nine nuclear power stations are included as examples of the studies conducted. (CH)

10897 (BNWL-1750(Pt.2), pp 3.1-3.3) THERMAL RESISTANCE OF MARINE ORGANISMS. Lichatowich, J. A.; Templeton, W. L.; Vanderhorst, J. R. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

The siting of nuclear power plants in coastal marine or estuarine areas has received increased attention because of the large volumes of water available for dilution of thermal effluents. Even though potential dilution factors may be satisfactory, recent environmental assessments, as prescribed by the National Environmental Protection Agency (NEPA), have revealed that standard research methodology may not provide the kinds of data required to resolve many of the problems associated with the use of marine or estuarine waters for cooling purposes. An attempt was made to develop experimental methodology predicated on recent experience in impact assessment that are directly responsive to the data requirements essential for NEPA review of nuclear power plant siting. Within the cooling loop of a once-through system, there are three types of thermal stress which may be lethal to marine organisms and these include: rapid thermal increases as organisms are passed through the condensers; prolonged exposure to elevated temperature in discharge canals, and thermal shock when organisms are entrained in the discharge plume from the cooler surrounding water. Studies to determine the thermal resistance of selected marine organisms subjected to the environmental conditions described above are reported. Cold shock, while recognized as a potentially lethal stress, was not included in these initial studies. Data are reported on the critical thermal maxima (CTM) of juvenile chum salmon, sand lance, and shiner perch. (CH)

10898 (BNWL-1750(Pt.2), pp 6.1-6.2) FISH BEHAVIOR: THERMAL EFFECTS. Page, T. L.; Schneider, M. J. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

Preliminary results are reported from studies on the effects of thermal stress on the behavior of Columbia River fish. The design and location of the test chamber are discussed. (CH)

10899 (BNWL-1750(Pt.2), pp 6.2) THERMAL RESISTANCE OF AQUATIC INVERTEBRATES. Becker, C. D.; Genoway, R. G. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

Continuing studies are designed to provide experimental data on the thermal resistance of endemic invertebrates inhabiting the central Columbia River. This program is based on the rationale that direct discharges of heated effluents from operating nuclear power plants may impose an ecologically significant modification of the aquatic environmental for cold-blooded organisms. Results are reported from an extensive series of bioassays to determine the resistance of native crayfish, Pacifasticus trowbridgi (Crustaces: Decapoda) to acute thermal shock. (CH)

10900 (BNWL-1750(Pt.2), pp 6.2-6.4) THERMAL TOLERANCE OF NONSALMONID FISH. Becker, C. D.; Genoway, R. G. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

Data on juvenile cyprinid and catostomid nonmigratory fish endemic to the Columbia River that encounter heated water of a discharge plume during winter showed that exposure to elevated temperatures up to ΔT 20°C is not apt to cause acute mortality, and that death will occur rapidly within a few degrees once the critical thermal level is passed. (CH)

10901 (BNWL-1750(Pt.2), pp 6.4-6.6) THERMAL AND THERMAL-EXERTION STRESS TO FISH MEASURED IN BLOOD GLUCOSE AND LACTIC ACID LEVELS. Schneider, M. J.; Genoway, R. G. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

A method for measuring the combined effects of thermal and fatigue stress in fish was developed. Rainbow trout were forced to swim against controlled velocities of heated water. Blood samples were taken from the dorsal aorta after stress from exercise and/or thermal shock and the resulting glucose and lactic acid measurements were determined. No difference was found in glucose and lactic acid levels in blood taken from 10.5°C acclimated fish subjected to a 28°C thermal shock when compared to a second group of the same thermal experience with exercise at 1 ft/sec added. Tests showed no significant difference at the 0.05 level, for time to loss of equilibrium in fish subjected to lethal temperatures in static water over fish forced to swim in running water of similar temperatures. (CH)

10902 (ORNL-EIS-73-28) THERMAL EFFECTS ON AQUATIC ORGANISMS: ANNOTATED BIBLIOGRAPHY OF 1972 LITERATURE. Coutant, C. C.; Pfuderer, H. A. (comps.) (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 187p. Dep. NTIS $11.50.

Some 400 abstracts from the 1972 world literature on thermal effects on aquatic organisms are presented. (CH)

10903 (ORNL-TM-4195) ACTIVITIES REPORT: BENEFICIAL USES OF WASTE HEAT COVERING ORNL ACTIVITIES THROUGH DECEMBER 31, 1972, IN THE JOINT AEC(ORNL)-TVA PROGRAM. Furlong, W. K.; Lundin, M. L.; Wilson, L. V.; Yarosh, M. M. (Oak Ridge National Lab., Tenn.). June 1973. Contract W-7405-eng-26. 31p. Dep. NTIS $4.00.

Under a cooperative program established between the Atomic Energy Commission and the Tennessee Valley Authority, the Oak Ridge National Laboratory is participating with the TVA on a project to demonstrate the use of waste heat from a steam-electric power plant. The demonstration will require the construction of a large (approximately one acre) greenhouse that will be heated and cooled by reject heat from the Brown's Ferry Nuclear Plant. In order to procure engineering and agricultural information necessary to the design of the Brown's Ferry facility, a 2500 square foot pilot research greenhouse was designed and erected at the TVA Muscle Shoals Facility. Initial operation of the pilot research facility will be in the spring of 1973. (auth)

10904 QUANTITATIVE SAMPLING OF LIVE ZOOPLANKTON WITH A FILTER-PUMP SYSTEM. Icanberry, J. W.; Richardson, R. W. (Pacific Gas and Electric Co., Emeryville, CA). Limnol. Oceanogr.; 18: No. 2, 333-335(Mar 1973).

A conventional plankton net was inadequate for study of the survival of zooplankton passing through the cooling water systems of thermal power plants. A filter collection system was designed which allows survivals of 90-95% by reducing water velocities and

turbulence within the collection chamber. Comparisons of fishing abilities did not show any significant differences between a filter pump and a plankton net. (auth)

10905 ESTABLISHMENT OF THERMAL LOAD PLANS BY MATHEMATICAL SIMULATION OF THE HEAT EXCHANGE PROCESSES AS SHOWN BY THE EXAMPLE OF THE WAERMELASTPLAN RHEIN. Flinspach, D. (Innenministerium Baden-Wuerttemberg, Stuttgart); Fleig, H. Wasserwirtschaft; 65: No. 5, 127-133(1972). (In German).

The increase in thermal pollution of rivers poses the question of tolerable limits of such pollution. This problem caused the establishment of the Waermelastplan Rhein–Aaremuendung bis hollaendische Grenze (Rhine Thermal Load Plan). The temperature predictions in this study were obtained by mathematical simulation of heat exchange processes in the environment. This mathematical treatment is described in detail. The authors were principally concerned with obtaining the fundamental data and establishing the Waermel astplan Rhein. (GE)

Chemical Effluents

Refer also to abstracts 10856, 10872, 10896, 12500, and 12506.

10906 (BNWL-SA-4525) METHODS FOR REDUCING DEMINERALIZER WASTE DISCHARGES FROM THERMO-ELECTRIC POWER PLANTS. Mercer, B. W.; Jaske, R. T. (Battelle Northwest, Richland, Wash. Pacific Northwest Lab.). 25 Apr 1973. 14p. (CONF-730433-3). Dep. NTIS $3.00.

From national conference on complete water use; Washington, District of Columbia, USA (23 Apr 1973).

The discharge of ion exchange demineralizer regenerant wastes to freshwater lakes and streams contributes to quality deterioration of our water supplies. Acceptable disposal methods for these wastes, such as ocean dumping and deep well injection, are costly for those plants which do not have ready access to a disposal site. Rather than pursuing the waste disposal problem, it may prove more profitable to consider alternate methods of producing demineralized water for boiler feed. Substantial reductions in the volume of demineralizer waste can be achieved by use of systems which combine reverse osmosis or electrodialysis with ion exchange. Additional benefits which can result from the use of these systems are: (1) reduced water production costs for plants with make-up water containing high concentrations of dissolved solids, and (2) the production of higher quality demineralized water. Preliminary investigations indicate that steam generator blowdown can be treated by a reverse osmosis-ion exchange system to produce water of sufficient quality for reuse. (auth)

10907 (WASH–1249) TOXICITY OF POWER PLANT CHEMICALS TO AQUATIC LIFE. Becker, C. D.; Thatcher, T. O. (comps.) (Atomic Energy Commission, Washington, D. C.). Jun 1973. 230p. GPO $1.25.

A review was made to determine the various chemicals actually or potentially associated with the operation and maintenance of nuclear power plants and cooling tower structures. A tentative list of these chemicals is presented. The in-plant application of the various chemicals, their reactions with other compounds and water, and the resulting materials that may occur in plant effluent discharges are briefly discussed. Data from technical publications concerning the specific toxic levels of power plant chemicals and their products to aquatic life are tabulated under the following categories: acids; acrolein; arsenates and arsenites; ammonia, amines, and related compounds; boron; carbonates; chlorine and bromine; chlorinated and/or phenylated phenols; chromates; cyanurates and cyanides; hydrazine compounds; hydroxides; metals and their salts; nitrates and nitrites; potassium compounds; phosphates; silicates; and sulfates, sulfides, and fluorides. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 10808, 11024, and 11076.

10908 (BARC-650) SILICON (N-TYPE) SURFACE BARRIER DETECTORS. Chaudhry, R.; Hegde, K. H. V. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

Development work has been carried out on the process of fabrication of gold–silicon (n-type) surface barrier detectors. A large number of detectors have been fabricated mostly with large sensitive areas from high resistivity silicon. The process used produced detectors with extremely good performance characteristics. Typical detector characteristics obtained with silicon of 10,000 ohms-cm resistivity are: sensitive area: 250 mm^2 approx; depletion depth: 300 to 500 microns; energy resolution: 27 to 40 keV for 5.48 MeV alpha particles; leakage current: 0.5 to 1 microamp. at 50 to 100 volts bias. Method of fabrication is described with complete details. The process is highly suitable for production. (auth)

10909 (CALT-767-P-11-X-5) STUDY OF DEEP LEVELS IN DETECTOR-GRADE GERMANIUM BY CHARGE TRANSPORT TECHNIQUES. Report No. 6. Marrello, V.; Ottaviani, G.; Krautle, H.; Mayer, J. W.; Nicolet, M. A. (California Inst. of Tech., Pasadena. Dept. of Electrical Engineering). 20 Mar 1973. Contract AT(04-3)-767. 12p. Dep. NTIS $3.00.

The hole drift velocity in high-purity Ge as a function of electric field (2 to 10^4 V/cm) and temperature (8 to 220°K) was measured with the time-of-flight technique. The electric field was applied parallel to the ⟨100⟩ axis. The drift mobility in the ohmic regime is in agreement with measurements of Hall mobility in high purity Ge and with theoretical predictions. At temperatures below 100°K the drift velocity reaches limiting values, and at 8°K it is 1.3×10^7 cm/s. (auth)

10910 (CONF-730627-1) A FAMILY IMAGE FOR EVALUATION OF IMAGE PROCESSING METHODS. James, G. D.; Ross, D. A.; McClain, W. J.; Bell, P. R. (Oak Ridge National Lab., Tenn.). 1973. 4p. Dep. NTIS $3.00.

From third symposium on the sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

The production of a synthetic image for a specific radioisotope in a phantom (called a family image) is discussed. The family image concept was developed for testing image enhancement methods for gamma scanners and radioisotope cameras, for training technicians, and for studying instrument parameters. (WHK)

10911 (N-72-25743) SOFT X-RAY ASTRONOMY PROPORTIONAL COUNTER ELECTRONICS. Gardner, W. R. (Lockheed Electronics Co., Inc., Houston, Tex. (USA). Houston Aerospace Systems Div.). Dec 1971. 176p. (NASA-CR-115509). NTIS.

The x-ray multiwire proportional counter is designed to measure cosmic x-ray fluxes at sounding rocket altitudes in the energy range of 0.1 to 10 keV. Four instruments will be launched in a Black Brant 4 rocket employing different combinations of detector windows and gas. The detector is constructed with two layers of twelve cells. A columnator is mounted on the face of one layer whose cells are wired together alternately to form two main detector sections. The electronics and gas regulation systems are mounted on the face of the second layer whose cells are wired together to form one anticoincidence detector section. Normally x-rays will have short ionization paths in only one of the main detector cells at a time and won't enter the anticoincidence detector cells. To distinguish between x-rays and charged particles, the instrument includes a coincidence discriminator, an anticoincidence discriminator, and a pulse rise time discriminator. (auth)

10912 (UCRL-51371) LLL 18-INCH WILSON CLOUD CHAMBERS. Griffin, G. (California Univ., Livermore. Lawrence Livermore Lab.). 23 Apr 1973. Contract W-7405-eng-48. 12p. Dep. NTIS $4.00.

A Wilson cloud chamber 18 in. in diameter and 8 in. deep is described. A number of these chambers have been used in the LLL in the "quark hunt." They have versatile electronic controls and operate at about atmospheric pressure and ambient temperatures. Operating parameters and some engineering details are given. Some of the difficulties in the operation of the chamber are discussed. (auth)

10913 CONTEMPORARY STATE AND DEVELOPMENT TRENDS IN THE METROLOGY OF NEUTRON RADIATION. Vasil'ev, R. D. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 12, 1840-1844(Dec 1972).

Translated from Izmer. Tekh.; 15 No. 12, 59-62(Dec 1972).

Progress and problems related to the detection, dosimetry, and spectroscopy of neutrons including direct measurements, indirect measurements, and combined measurements are discussed. (WHK)

10914 INTERPOLATION OF NONLINEAR QUENCH CORRECTION CURVES FOR A LIQUID SCINTILLATION COUNTER USING AN OLIVETTI 101 CALCULATOR. Hope, H. J. (Canada Dept. of Agriculture, Quebec). Anal. Biochem.; 53: No. 1, 295-298(May 1973).

A calculational method for interpolating the nonlinear variation of efficiency with the external standard ratio for a liquid scintillation detector is given. (WHK)

10915 CURRENT GENERATION IN A SELF-POWERED RHODIUM EMITTER NEUTRON DETECTOR. Mitin, V. I.; Shikalov, V. F.; Tsimbalov, S. A. At. Energ. (USSR); 34: No. 4, 301-303(Apr 1973). (In Russian).

The self-powered detectors (SPD) with Rh emitters 50 and 100 mm in length, were placed in a channel in a reactor in order to study the effect of γ-radiation on the SPD operation. Connections were made to amplifiers and oscilloscopes using 16 m of doubly-shielded cable. The SPD current was measured with the SPD located in the core, and during rapid withdrawal from the core. The results were interpreted in terms of the reactions $^{103}Rh(n,\gamma)^{104m}Rh$, ^{104}Rh. (KSW)

10916 PRESENTATION OF ACTIVITY DISTRIBUTIONS IN THREE-DIMENSIONAL REGIONS. Adomssent, S.; Potschwadek, B. (Univ., Rostock, Ger.). Exp. Tech. Phys.; 20: No. 6, 521-523(1972). (In German).

Questions of presentation play a large role in the evaluation of scintigrams. Digital computers with line printers allow a variable, clearly arranged and information-rich presentation. The subjective evaluation of the picture can proceed through additionally calculated parameters more reliably. (tr-auth)

Radiation Dosimeters

Refer also to abstracts 10766, 11041, and 11378.

10917 (IFA-PN-26-1972) DOSIMETRY OF HEAVY CORPUSCULAR RAYS ($Z \geq 2$) WITH THE ASSISTANCE OF A NUCLEAR EMULSION AND SOLID TRACK DETECTORS. Haseganu, D.; Nicolae, M. (Institutul de Fizica Atomica, Bucharest (Romania)). [nd]. 12p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

A method for the dosimetry of heavy corpuscular rays is presented. It is based on the use of mixed packages of nuclear emulsions and solid track detectors of cellulose nitrate. In order to reduce the fading of the latent image during exposures of long duration, the use of an emulsion of high sensitivity associated with a discriminatory development method is proposed. This allows the development of all the particles having a specific energy loss higher than a given threshold value. In this method the ion spectrum is divided into ionization groups. A very large interval of the energy spectrum of the ions present in primary cosmic rays is covered. (JSR)

10918 (UCRL-51393) NEUTRON DOSIMETRY (14 MeV) FOR FOIL SAMPLES IRRADIATED WITH THE LAWRENCE LIVERMORE LABORATORY ROTATING TARGET NEUTRON SOURCE. Van Konynenburg, R. A. (California Univ., Livermore. Lawrence Livermore Lab.). 17 Apr 1973. Contract W-7405-eng-48. 15p. Dep. NTIS $4.00.

The Lawrence Livermore Laboratory Rotating Target Neutron Source is being used to irradiate small metal and insulator samples to fluences of about 10^{17} 14-MeV neutrons/cm^2 as part of radiation-damage studies in support of the Controlled Thermonuclear Research materials effort. Because of the characteristics of the neutron source, foil activation must be used for accurate dosimetry. Niobium is the material of choice for dosimetry. Present techniques yield an absolute accuracy of 7.5% in fluence for small samples. (auth)

10919 STATE STANDARD FOR THE UNIT OF ABSORBED DOSE OF BETA AND NEUTRON RADIATION. Yudin, M. F.; Uryaev, I. A.; Yanovskii, A. P. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 12, 1772-1776(Dec 1972).

Translated from Izmer. Tekh.; 15 No. 12, 20-22(Dec 1972).

USSR standard equipment for measuring the absorbed dose of beta radiation and neutrons in a tissue equivalent medium is described. An extrapolation parallel-plate ionization chamber having organic-glass walls and containing air at atmospheric pressure is used for absorbed beta dose. A cavity-type, tissue-equivalent ionization chamber containing a mixture of methane, carbon dioxide, and nitrogen at a pressure of 0.101325 decabar and a graphite ionization chamber containing carbon dioxide at the same pressure are used for absorbed neutron dose. (WHK)

10920 CHANGE IN OPTICAL PROPERTIES OF A POLYETHYLENE TEREPHTHALATE FILM UPON IRRADIATION WITH 25 TO 150 keV PROTONS. Kapchigashev, S. P.; Kovalev, V. P.; Sokolov, V. A.; Barkhatov, E. S. At. Energ. (USSR); 34: No. 4, 299-300(Apr 1973). (In Russian).

The change in optical properties of a film upon exposure to ionizing radiation offers possibilities for its use in dosimetry. The dosimetric characteristics of a 9.5-μ-thick film of polyethylene terephthalate were studied by irradiating it with 25 to 150 keV protons and determining the absorption spectra of the altered film at 320 nm. The irradiated film retained its altered spectral characteristics for at least two months during storage in the dark at room temperature. (KSW)

10921 LYOLUMINESCENCE AS A POSSIBLE BASIS OF RADIATION DOSIMETRY. Atari, N. A.; Ettinger, K. V.; Fremlin, J. H. (Univ. of Birmingham, Eng.). Radiat. Eff.; 17: No. 1-2, 45-48(Jan 1973).

It has been reported that the dissolution of some irradiated solids in certain liquids results in the emission of light. Accordingly, different materials were studied including γ-irradiated alkali halides and saccharides with water or some fluorescent systems as solvents. Doses ranging between 1 and 10^7 rads were measured, using NaCl, with an accuracy of ±5% and high reproducibility. Some thermoluminescence experiments were made to optimize the conditions affecting the retention of the stored energy. A few spectroscopic experiments were also done to study the emission spectra of the light produced in the process of dissolution. (auth)

10922 LiF DOSIMETRY IN THE REGION OF INTERFACES BY WAY OF THE EXAMPLE OF THE BUILD-UP EFFECT OF ^{60}Co γ RADIATION. Tode, D. (Zentralinstitut fuer Radiologie, Karl-Marx-Stadt, Ger.). Exp. Tech. Phys.; 20: No. 6, 479-487 (1972). (In German).

The explanation of the basic principles of absorbed dosage measurement with a high-energy quantum radiation in regions of large dose gradients is followed by the introduction of a recent LiF dosimetric system used for such types of measurement. The dosimeter is very simple in construction, and ensures a high resolving power because of the limited thickness of the LiF measuring layer of nearly 0.2 mm. Special importance can be attached to the proposed LiF dosimeter for medical radiology in experimental studies of dose behavior at interfaces between various tissues. Its practicability has been proven by way of the measurement example of the build-up effect of ^{60}Co-γ-radiation. (auth)

10923 DOZIMETRY. (Dosimetry). Skotnikov, V. T.; Laptev, V. V. Moscow; Atomizdat (1973). 104p.

Systems of dosimetric control, dosimeters for γ-radiation of various designs, and their maintenance and repair constitute the subject matter for this book. Schematic diagrams for the basic circuitry of calibration panels, modulators, cascade amplifiers, synchronous detectors, power supplies, converters, and signal analyzers are depicted. Nine references. (KSW)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 12076.

10924 (BMFT-FBK-73-9) NEW SEMICONDUCTORS OUT OF ELEMENTS WITH HIGH ATOMIC NUMBER FOR THE DETECTION OF γ-RAYS AND X-RAYS. Willig, W. R. (Siemens, A.G., Erlangen (West Germany). Forschungslaboratorien). Apr 1973. 72p. (In German). Dep. NTIS (U.S. Sales Only) $5.75.

A gamma spectrum with 10% resolution was made with HgI_2 single crystals grown by transport techniques or solution growth. The detector works at room temperature with a high absorption coefficient and consequently reduced thickness, compared with germanium detectors. Research was done on other materials, for which the product of mobility and lifetime is given as follows: α-PbO: 10^{-6} cm^2/V; β-PbO: 10^{-5} cm^2/V; PbJ_2: 10^{-9} cm^2/V; and HgJ_2: 10^{-4} cm^2/V. (auth)

10925 (BNL-17873) BNL MULTI-PARTICLE SPECTROMETER. Platner, E. D.; Foley, K. J.; Kramer, M. A.; Love, W. A.; Miller, W. J.; Morris, T. W.; Ozaki, S.; Saulys, A. C.; Willen, E. H.; Lindenbaum, S. J. (Brookhaven National Lab., Upton, N. Y.; City Coll., New York). [nd]. 21p. (CONF-730531-3). Dep. NTIS $3.25.

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973).

Work is in progress at BNL to build a large multi-particle spectrometer (MPS). The MPS is briefly described. Four planned experiments for the facility when completed are discussed. (TFD)

10926 (BNWL-SA-4616) GAMMA-RAY SPECTRUM ANALYSIS USING A LABORATORY COMPUTER WITH SPECIALIZED HARDWARE AND SOFTWARE. Kosorok, J. R. (Battelle Pacific Northwest Labs., Richland, Wash.). 20 Apr 1973. 34p. (CONF-730536-2). Dep. NTIS $3.75.

In the Radiological Chemistry Section of Battelle-Northwest, computer software and interface hardware have been developed for the laboratory computer (a PDP-15/30) to form a system that acquires and quantitatively analyzes gamma-ray spectra. The spectra may be acquired using the computer and its interfaced pulse height-to-digital converter as a programmed multichannel analyzer, they may be transferred to the computer from hard-wired analyzer memories, or they may be read from DECtapes, which have spectra written on them from analyzer memories. The use of the system as a programmed analyzer to acquire spectra and a related set of programs for quantitative analysis was previously reported. The operation of the system in its other acquisition and analysis modes is discussed. We have spectrometer systems with single and dual Ge(Li) detectors that are close to the computer system and systems with dual NaI(Tl) detectors that are remote from the computer. Spectra from the analyzer memories of the Ge(Li) spectrometers are transferred directly to the computer memory over an eight-channel input device. Programs were written to control the device and convert the data formats from binary-coded-decimal to binary. Presently the data on DECtapes from the NaI(Tl) systems have to be modified using special programs to be compatible with the standard data forms of the PDP-15/30. Typical problems for which the computer system are used include neutron activation analysis and measurements of environmental radioactivity. In this latter case, the analysis program calculates errors by considering uncertainties contributed by the standard, background and sample spectra. (WHK)

10927 (COO-2231-2) NEUTRON SPECTROMETRY FROM 1 MeV TO 1 GeV. Madey, R.; Waterman, F. M. (Kent State Univ., Ohio (USA). Dept. of Physics). 1972. 25p. (CONF-721203-12). Dep. NTIS $3.25.

From symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

Results of neutron spectra measurements with a time-of-flight spectrometer at the Berkeley 184-Inch Cyclotron are given for neutrons in the energy range from 1 to about 725 MeV. (TFD)

10928 (LA-UR-73-601) EXPANDED FOCAL INTERPRETER FOR REAL-TIME DATA ACQUISITION AND ANALYSIS. East, L. V. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 7p. (CONF-730536-1). Dep. NTIS $3.00.

An expanded PDP-9 FOCAL interpreter has been adapted for use in real-time acquisition, presentation, and analysis of nuclear spectroscopy data. Extensions to the FOCAL language allow the use of doubly subscripted variables, computed branch instructions, and expressions in response to ASK commands. New commands have been added, including an OPERATE command for I/O control and additional LIBRARY commands. (auth)

10929 (ORNL-TM-4091) COMPUTER-CONTROLLED NEUTRON TIME-OF-FLIGHT SPECTROMETER. Merriman, S. H. (Oak Ridge National Lab., Tenn.). Jul 1973. Contract W-7405-eng-26. 84p. Dep. NTIS $6.25.

A time-of-flight spectrometer for neutron inelastic scattering research at the Oak Ridge HFIR has been interfaced to a PDP-15/30 computer, using a library of programs developed for collecting and analyzing a variety of experimental data. Brief descriptions of the spectrometer and interface hardware are given, and the programming involved is discussed. (auth)

10930 CURRENT STATUS AND POTENTIAL OF SOLID-STATE DETECTORS IN INDUSTRIAL AND FIELD APPLICATIONS. Langheinrich, A. P.; Forster, J. W.; Linn, T. A. Jr. (Kennecott Copper Corporation, Salt Lake City). pp 429-471 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

Energy dispersive x-ray (EDX) analysis instrumentation based on solid-state detectors has begun to make its impact on the

mineral industries. Beyond use in feasibility studies and research and development applications, it has been introduced recently into production plants for process and quality control. A review is made—from a user's viewpoint—of such analytical systems, their requirements and potential. Examples are provided of specific applications, including previously unpublished work. Developments related to detector and cooling technology are discussed briefly. The question of fruitful communication between users, manufacturers and the research community is raised, and predictions are made as to future trends for the technique. The review also includes information on the use of solid-state detectors in activation analysis. Overall, the striking technological advances and the successful applications work of the past six years point to a decade of significant expansion in the use of semiconductor solid-state detector systems in the mineral industries and in other industrial and non-industrial fields as well. (119 references) (auth)

10931 γ-RAY SPECTROMETER PROBE FOR THE MEASUREMENT OF RADIOACTIVE POLLUTION IN THE SEA. Wedekind, C. (Deutsches Hydrographisches Inst., Hamburg). Health Phys.; 25: No. 1, 51-58(Jul 1973).

The mechanical and electrical construction of the probe is described. In order to provide a critical judgment of the applicability of this probe in operation, the necessary calibration curves for spectrometrical and total-gamma measurement are included as well as the calibration methods used. To improve the instrument's accuracy for γ-spectrometry in water, the attachment of a lead cylinder is recommended, however, for total-gamma measurements on the seabed an arrangement for "offset" geometry is required. The conditions for measurement in the sea and their influence upon the limits of detection are investigated. (auth)

10932 MODERN MOESSBAUER SPECTROMETERS. Forster, A. A.; Halder, N.; Kalvius, G. M. (Technische Univ., Munich). Messtechnik; 80: No. 12, 347-357(1973). (In German).

The principles of modern, high resolution velocity spectrometers for Moessbauer spectroscopy are described. A special instrument which allows the simultaneous recording of four Moessbauer spectra is described. This system uses a minicomputer for data handling. (GE)

High Energy Physics Instrumentation

Refer also to abstract 11688.

10933 (ANL/HEP-7314) ARGONNE EFFECTIVE MASS SPECTROMETER. Ayres, D. S. (Argonne National Lab., IL). Apr 1973. 4p. (CONF-730531-1). Dep. NTIS $3.00.

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973).

The heart of this facility is a large aperture dipole magnet surrounded by magnetostrictive readout spark chambers, with an online EMR-6050 computer. It is supplied with unseparated positive or negative beams of up to 6 GeV/c from the Zero Gradient Synchrotron (ZGS). The spectrometer is distinguished by good resolution (effective mass resolution ±3 MeV for K^0's) and a high data rate capability (up to 45 events per beam pulse). The hardware is quite flexible, allowing target geometry and triggering schemes to be changed easily. A set of four cylindrical spark chambers around a hydrogen target was recently installed and is performing well. The facility has been extremely productive, with data taking for seven experiments being completed in 13 months of running. Future experiments include studies of pp interactions with a polarized proton beam. (auth)

10934 (JINR-P13-7067) NEW PRINCIPLE OF RECORDING THE PARTICLE TRACKS IN LIQUID AND CRYSTALLINE MEDIA. Pisarev, A. F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 14p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A new principle is introduced and analyzed for particle track recording in liquid and solid media by means of selective resonance pumping of energy at the place of breaking the media structure by particle tracks and by generation (in their neighborhood) of optical inhomogeneities of visible size. In particular, it is shown that by using the ortho-para-transition of molecules one can construct liquid- and solid-hydrogen track chambers with a selective control regime and a memory time of 10^{-6} to 10^{-7} s and a reconstruction time of 10^{-5} to 10^{-6} s. (auth)

10935 (LAL-1265) SEVERAL PROPERTIES OF MULTIWIRE PROPORTIONAL COUNTERS. Boucrot, J.; Cordier, A.; Nguyen Ngoc, H.; Roudeau, P. (Paris Univ., Orsay (France). Laboratorie de l'Accelerateur Lineaire). Feb 1973. 59p. (In French). Dep. NTIS (U. S. Sales Only) $5.00.

Calculations and measurements made on multiwire proportional counters during the last four years are summarized. The avalanche and multiplication mechanisms in the gas of a proportional counter are first reviewed. A description is then given of the construction of nine multiwire chambers. $\gamma d \rightarrow \pi^- pp$ experiments with these counters are then summarized. The problems relative to the derivative speed of electrons in the gas and their application to drift chambers are reviewed. (JSR)

10936 (LBL-1750) USING HIGH SPEED DIGITAL INTEGRATED CIRCUITS FOR NUCLEAR INSTRUMENTATION. Althaus, R. F.; Lee, K. L.; Kirsten, F. A.; Wagner, L. J. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-eng-48. 7p. (CONF-730531-4). Dep. NTIS $3.00.

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973).

Commercially available high speed digital integrated circuits (I.C.'s) now have performance characteristics and economy that make them attractive as central logical elements around which state-of-the-art instruments for high energy physics can be developed. In work reported five years ago commercial I.C.'s were shown to offer advantages of economy and packaging density, which were valued in some large system arrays, but their performance was below that of the 200 MHz commercially available counting equipment. No longer must speed, or resolution, be comprised for these advantages. Circuits now configured around the Motorola MECL III line of integrated circuits provide 300 MHz speed, 1.2 ns maximum rise- or fall-time, coincidence recognition for 1 ns overlap, and inherent coincidence time resolution edges of less than 40 ps (1000:1 count rate). Two modular packaging schemes using MECL III I.C.'s have been developed at the Lawrence Berkeley Laboratory. The first to be described, called the FLOGIC System, achieves high packaging density by means of logic cards that are interconnected in a custom design unique to each experiment. The FLOGIC System is most suitably used where many channels of instrumentation are required and the configuration of these channels, once established, is not subject to frequent unprescribed change. The second scheme uses the NIM Standard hardware. This scheme offers the convenience and versatility of standardized hardware and signal levels. (auth)

10937 (LBL-1791) HIGH-RESOLUTION LIQUID-FILLED MULTI-WIRE CHAMBERS FOR USE IN A HIGH-ENERGY BEAMS. Derenzo, S. E.; Schwemin, A.; Smits, R. G.; Zaklad, H.; Alvarez, L. W. (California Univ., Berkeley. Lawrence Berkeley Lab.). Apr 1973. Contract W-7405-eng-48. 8p. (CONF-730531-6). Dep. NTIS $3.00.

From international conference on instrumentation for high energy physics; Frascati, Italy (8 May 1973).

Experiments with liquid-xenon-filled wire chambers operating in the proportional mode are described, and the difficulty of achieving useful gain when the anode wires have a spacing <1 mm is discussed. As a result, chambers with closely spaced wires operated in the ionization mode have been developed. A spatial resolution of 15 μ rms in this mode, using a 5-wire chamber and a collimated alpha source, was demonstrated. The construction of two small high-resolution test chambers to be filled with liquid argon, krypton, or xenon is described. The chambers consist of two flat cathodes 1 to 2.5 mm apart with a wire plane between them. The wire plane is an array of 24 wires, 5 μ in diameter, spaced on 20-μ centers, and a charge amplifier is attached to each wire. The space resolution (expected rms <20 μ), time resolution (expected rms <50 ns), and efficiency will be measured in an accelerator beam. Chambers of this type with only a few hundred wires have sufficient area to cover nearly every beam at NAL. (auth)

10938 MEASUREMENT OF THE ENERGY OF RELATIVISTIC PARTICLES WITH THE AID OF AN ONDULATOR IN AN OPTICALLY TRANSPARENT MEDIUM. Ginzburg, V. L. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 16: No. 8, 357-359(20 Oct 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 8, 501-504(20 Oct 1972).

The possibility of combining a Cherenkov counter with an ondulator counter for measurement of the total energy of an individual particle in the ultrarelativistic range is briefly discussed. (An ondulator counter works on the principle of radiation emission due to particle oscillations about a straight-line trajectory under the action of an alternating electric field or a spatially periodic magnetic field.) It is pointed out that when a transparent medium is present in the ondulator, the radiation intensity increases sharply under certain conditions. (WHK)

10939 KINETICS OF THE INCREASE OF BUBBLES IN THE TRACKS OF BUBBLE CHAMBERS. Atamuratova, K. M. Izv.

Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 1-6(1972). (In Russian).

A differential equation for the thermal conductivity for a growing bubble in a bubble chamber is derived, and approximate solutions near the bubble surface are proposed. Dependence of bubble radius on time, and dependence of the temperature on the distance from the bubble center at various moments of time are discussed. A substantial influence of temperature on bubble growth is demonstrated for propane under conditions of constraint; this effect is much less manifest for hydrogen. (tr-auth)

Radiometric Instruments

Refer also to abstracts 10764, 10930, and 10967.

10940 USE OF RADIOISOTOPE NEUTRON ACTIVATION AND X-RAY FLUORESCENCE ANALYSERS IN PROCESS CONTROL. Lundan, A. I.; Mattila, O. P. (Outokumpu Oy, Tapiola, Finland). pp 3-19 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

In the neutron activation and x-ray fluorescence analysers constructed by the Research Laboratory of Outokumpu Oy in Tapiola, Finland, appropriate radioisotope sources provide the means of activation or excitation of the samples. The instruments are described and their typical applications in the basic metal industries are discussed. A computer-coupled combination of the two analysers with its application for analysis of the principal components of a cement raw mix is also described. Samples in the form of solid powder, liquid or slurry may be analysed in the activation analyser. The sample is activated by the fast neutron spectrum of a ^{238}Pu-Be source and the activity induced is measured by a large well-type NaI scintillation detector. The elements which are most favorably determined by this analyser are Si, Al, P, F and Cr. Numerous applications can be found in industrial process control such as in iron-ore and chrome-ore concentration plants and in cement manufacture. Determination of Si and Cr in chrome concentrates is discussed in detail. Based on the experience gained at the Kemi chrome-ore concentration plant, the analyser has proved to be extremely stable and maintenance-free, and typical accuracy achieved is 0.1% SiO_2 at 4% mean SiO_2 level and 1.0% Cr_2O_3 at 43% mean Cr_2O_3 level. The radioisotope XRF analysers developed include a multi-element laboratory model with three interchangeable sources and seven balanced filter pairs, and a simpler model with one source and no balanced filters. A sealed proportional counter filled with argon-methane mixture is used as the detector. At the Kemi concentration plant an XRF spectrometer using a 10-mCi ^{238}Pu source and a differential filter pair has been used to determine Cr in chrome ore and tailings. Some other potential applications of the analyser, partly evaluated in practice, are the determination of Cu, Sn or Pb in certain brasses, analysis of Ti in iron-titanium ore and of S in lubricating oils. The two analysers are combined in a system specifically developed for analysis of the principal components of a cement raw mix. The results achieved are briefly described as an example of what might be expected from the application of combined NAA/XRF techniques for the determination of light elements under similar requirements in the metal industries. (auth)

10941 APPLICATIONS OF NONDISPERSIVE X-RAY FLUORESCENCE ANALYSERS IN THE BASIC METALS INDUSTRY. Papez, K.; Cameron, J. F. (Nuclear Enterprise Ltd., Reading, Eng.). pp 21-36 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

In the basic metals industry nondispersive x-ray fluorescence analysers are used at all stages from mineral processing, melting and refining to quality control of the finished products. The analysers take various forms depending on their application, e.g., portable, transportable, laboratory or on-line. Accuracy of measurement depends on the element of interest and the form and composition of the host matrix, and simple methods exist to minimize errors arising from matrix variations. The different types of analysers and their applications are described, and factors affecting accuracy are discussed. (25 references) (auth)

10942 NUCLEAR MOISTURE-MEASUREMENT AND A NEW METHOD OF CALIBRATION. Grieser, F.; Klein, R. (Mannesmann AG Huettenwerke, Duisburg, Ger.). pp 73-91 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314, CONF-720704-.

After much unsatisfactory experience in calibrating nuclear moisture-measurements for coke the instrumentation maintenance division of Mannesmann AG Hüttenwerke in Duisburg decided to develop a fast and reliable method of calibration for a moisture-measuring device and to develop a moisture standard which can be adjusted and re-used. Calibration work was done by using a calibration bin, in which the moisture content could easily be changed. The moisture graduation was achieved by uniform drying of the coke, whereby a homogeneous distribution of moisture was achieved. Specific points of the calibration curve are taken over into a moisture standard (adjusted by the depth of immersion of cadmium sheets). This moisture standard will not only serve as a measuring standard for similar moisture-measuring equipment but will also be a control instrument for maintenance and repair work. (auth)

10943 MINERAL PROCESSING METHODS AND ON-STREAM ANALYSIS IN AUSTRALIAN MINERAL PROCESSING PLANTS. Watt, J. S. (Australian Atomic Energy Commission, Sydney); Howarth, W. J. pp 105-118 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

Physical methods of mineral beneficiation are briefly introduced with particular reference to froth flotation. A modern plant is described. The role of and economic advantages resulting from on-stream analysis for metal concentration are discussed. Radioisotope x-ray techniques for on-stream analysis are described and advantages of their use given. Probes containing radioisotope source and detector head unit can often be immersed directly into the plant process stream thus removing the need for sampling. Plant trials since 1964 in Australia have demonstrated that radioisotope techniques can be used under plant conditions. The accuracy of determination of metal concentration for each stream analysed in the plant trials is given. Plant installations and operating experience of on-stream analysers for determination of lead in flotation feeds at North Broken Hill Pty. Ltd and New Broken Hill Consolidated Ltd, and for copper and iron in flotation feeds at Kanmantoo Copper Pty. Ltd, are discussed. Use of analyzers for nickel, copper, zinc and lead in streams of a pilot plant at the Australian Mineral Development Laboratories is briefly described. (auth)

10944 APPLICATION OF RADIOISOTOPE X-RAY FLUORESCENCE TO THE STUDY OF MINERAL FLOATABILITY. Cesareo, R. (Univ., Rome); Frazzoli, F. V.; Beltrani, M. G. pp 119-130 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industires; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

A method is described for applying the technique for x-ray fluorescence excited by radioisotope sources to the study of floatability. With this technique it is possible to follow continously the changes in the concentration of an ore in a flotation cell. The advantages offered over other commonly used methods are: (a) variations in the concentration of an element characteristic of a given mineral can be determined without having to take samples; and (b) automatic measurements lasting a few seconds, run at intervals of about one hundredth of a second, provide a check on process trends. (auth)

10945 NUCLEONIC CONVEYOR-BELT WEIGHERS FOR THE BASIC METALS INDUSTRY. Boyce, I. S. (Atomic Energy Research Establishment, Harwell, Eng.); Cameron, J. F.; Piper, D. pp 155-162 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

With the increasing use of conveyor belts for handling bulk materials, there is an urgent need for improved methods of continuously monitoring feed-rates, both for inventory purposes and for production control. A nucleonic belt weigher consists essentially of a gamma-ray transmission gauge to measure mass of material per unit length of belt, a tachometer to measure belt velocity, and an electronic unit to process these two signals to indicate mass per unit time and integrate the signal to give total mass. The relative merits of nucleonic and electromechanical belt weighers are reviewed, and experiments leading to a design with optimum source geometry giving a measurement sensibly

independent of material profile and belt wander are described. Also, a new design incorporating a high efficiency detector and digital electronics giving high accuracy and immunity to interference in an industrial environment, which can readily be integrated with a central computer to control and optimize a large mineral processing plant, is described. Data from extended on-line trials are given which show that an accuracy of better than 1% can be achieved. (auth)

10946 APPLICATION OF GAMMA-RAY ABSORPTION TO THE DETERMINATION OF FLOW OF MATERIALS ON CONVEYOR SYSTEMS. Hold, A. C.; Morgan, D. W.; Williams, K. F. (British Steel Corp., Glamorgan, Eng.). pp 165-182 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

The use of the characteristic absorption of gamma radiation to determine the mass/unit area of material between a radiation source and a detector is well-known. When this technique is applied to determining the flow-rate or the integrated weight of particulate materials on a conveyor belt, the quantity of material over the whole cross-section must be determined together with the speed of the conveyor. Errors can arise by variation of the composition of the material, variation in its particle size and the form of deposition on the belt. Therefore it is difficult to forecast the performance of such a gauge in practice especially as quantitative information on the relevant variations is rarely available. Two types of nucleonic belt "weighers" have been evaluated in industrial conditions over an extended period for the determination of integrated quantities of iron-ores and coal. Comparisons are made with calibrated static weighbridges and difficulties in installation, calibration and maintenance noted. Where possible, suggestions for improvements are given and advantages and disadvantages when compared in principle and practice with commonly used mechanical weighers. (auth)

10947 ON-LINE NEUTRON MOISTURE GAUGES IN THE STEEL INDUSTRY, Papez, K. (Nuclear Enterprises Ltd., Reading, Eng.); Cameron, J. F.; Machaj, B. pp 183-191 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

Neutron gauges are now preferred for measuring the moisture content of many bulk materials in the steel industry, including blast furnace coke, sinter mix and iron ores. The transducer is mounted either in a probe protruding into a hopper, on the surface of the hopper or sometimes over a conveyor belt. The relative merits of the three systems are reviewed and experimental results on measurement sensitivity and the effects of wear of protective devices, linings or radiation "windows" are given. Empirical on-line measurements on blast furnace coke and sinter mix are described in detail including calibration, sources of error and automatic control. The design of a new conveyor belt moisture gauge is described and preliminary results are given. (auth)

10948 APPLICATION OF MEASUREMENT SYSTEMS USING RADIOISOTOPES IN THE NIPPON STEEL CORPORATION. Miyagawa, K. (Nippon Steel Corp., Kimitsu, Japan). pp 287-297 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

The application of on-line measurement systems has recently made remarkable progress in nearly every phase of work at the Nippon Steel Corporation. These systems are based on radioisotope instruments, such as neutron moisture gauges, level gauges, thickness gauges for steel sheets and strips, position indicators, coating thickness gauges, and density gauges for the raw materials and coke. Some of these radioisotope measurement systems, especially the recently developed ones, are described. One is the gamma-ray hot-strip crown meter used for non-destructive gauging of the edge-to-edge profile thickness of hot strips. Another is a three-directional thickness gauge for simultaneous measurement of web and flange thickness of H-rolled beams, which is an on-line gauge employing a 5-Ci ^{137}Cs source. Another device described is an interlock system for a coke-oven pusher which is an accident-prevention system comprising a ^{60}Co source located in the coke guide car and a detector placed on the coke pusher. (auth)

10949 DATA PROCESSING AND CONTROL SYSTEMS IN METAL COATING OPERATIONS. Donhoffer, D. K.; Beswick, C. K. (Elecktronische Instrumente und Kontrolleinrichtungen GmbH, Vienna). pp 299-317 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

Although discontinuous hot-dipping of steel sheets to coat with protective metals was introduced in the Eighteenth Century, it was only very recently that metallic coatings were applied in a continuous process to hot- and cold-rolled steel. This is done either electrolytically or by passing the steel strip through the molten coating metal. Initially, neither the nucleonic instrumentation used for coating weight measurement nor the controls for the coating process were sufficient to allow precise regulation of the coating weight. Radioisotope x-ray fluorescence (XRF) techniques now permit the accurate measurement of coating weight. At the same time, improvements in the coating process, such as the introduction of "jet-knife" systems in galvanizing operations, made automatic control of these processes a viable undertaking. The functional aspects of a widely used XRF coating weight gauge, its integration into a computerized data processing system, and the steps necessary to achieve full automatic control of metal coating processes are described. The resulting improvement in product quality and the savings in raw material through the use of these systems are discussed. (auth)

10950 PRIMARY ENERGY SELECTION IN NON-DISPERSIVE X-RAY FLUORESCENCE SPECTROMETRY FOR ALLOY ANALYSIS, AND COATING THICKNESS MEASUREMENT. Clayton, C. G.; Packer, T. W.; Fisher, J. C. (Atomic Energy Research Establishment, Harwell, Eng.). pp 319-354 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

In non-dispersive x-ray fluorescence spectrometry, highest excitation efficiency is achieved when the energy of the exciting radiation is restricted to an energy which is just above the absorption edge of the "wanted" element. The use of such monochromatic radiation also allows selective excitation of the characteristic x-rays of one or more elements in a group of elements of near-adjacent atomic number. This feature of a monochromatic exciting source is particularly valuable in alloy analysis and coating thickness measurement. Radioisotope secondary excitation sources generating quasi-monochromatic radiation have only found limited application so far, in particular where long measurement times can be tolerated: mainly for on-stream analysis of slurries in mineral processing plants. A new quasi-monochromatic radiation source has now been developed based on a small x-ray tube. It incorporates an energy selecting system which allows choice of the optimum exciting energy for a number of elements. It has a high output intensity compatible with solid-state detector, proportional counter or scintillation counter operation and can be incorporated into equipment for on-line and laboratory use. A comparison of this method of excitation with that using a primary radioisotope source for analysis of ferrous and non-ferrous metals is given. It is shown that in many cases a significant improvement in analytical capability can be made by using a selected energy for the exciting radiation. (auth)

10951 METHOD FOR THE CONTINUOUS MEASUREMENT OF THE BORON CONTENT OF LIQUIDS FOR EXAMPLE CIRCULATING CONSTANTLY IN REACTOR INSTALLATIONS. Sauter, E.; Weber, H. (to Siemens AG). German Patent 1,623,051. 13 Aug 1970. Filed date 29 Jun 1966. 12p. (In German).

A method for the continuous measurement of the boron content of liquids for example circulating constantly in a reactor installation is described. A small amount drawn off continuously from the principal liquid stream, irradiated with a constant nuclear radiation flux (for example thermal neutrons), and the α particles originating in the released nuclear reactions were registered and determined in the usual manner. The device for carrying out the method is described. The liquid is drawn up between a thermal neutron source and a large-surface counter and enters an overflow device made of slightly absorbing material whose height is so regulated that the flux density of the thermal neutrons is approximately equally large over the entire liquid volume to be irradiated. The neutron source or the entire device is surrounded by a neutron reflector. Between the neutron source, which can be a reactor, and the liquid to be irradiated, a layer is arranged as a moderator. For the irradiation of boron-containing heavy water, γ sources can be used. In the use of non-constantly ir-

radiating nuclear sources, shields, which can consist of layers of varying absorption capacity, can be placed between the source and the liquid. (JSR)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

10952 (CEA-R-4403) TECHNOLOGY OF ULTRASOUND TRANSDUCERS FOR NUCLEAR ENERGY. Fignon, M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jun 1973. 107p. (In French). Dep. NTIS (U.S. Sales Only) $7.50.

Thesis.

The different components of a nuclear reactor are subjected to very special conditions i.e., ionizing radiations, cycles, corrosion, etc. This investigation concerns the possibility of carrying out periodic in situ tests on certain elements (particularly the vessel of swimming pool type reactors). Ultrasound was chosen as the best detection system available for this purpose. These tests can only be carried out when the reactor is shut down. It is interesting, however, to know the behavior of ultrasound transducers when subjected to a flux of neutrons. The changes in the various components of the transducer when subjected to a neutron flux were studied. The use of resin matrices is not feasible even with a weak flux. Crystals, however, can be used with relatively high integrated radiation doses (4.10^{19} n/cm^{-2} thermal neutrons). In view of these results, an attempt was made to develop a damping procedure that would enable ultrasound techniques to be used under these special conditions. Examination of the results obtained enables the use of such transducers to be envisaged for this type of testing provided that the radiation intensity does not exceed a particular value. These investigations, which are as detailed as possible, can only be regarded as a step in the development of nondestructive testing techniques suitable for use in the presence of ionizing radiations. Improvements can be made in the manufacture of these transducers in order to enhance their performance. It should be emphasized that this utilization is in no way restrictive and that the technique could be adapted to other fields such as thickness measurements, distance measurements, etc., such as are practiced in classical testing procedures. (auth)

10953 (N-70-42732) ENGINEERING EXPERIMENTAL PROGRAM ON THE EFFECTS OF NEAR-SPACE RADIATION ON LITHIUM-DOPED SOLAR CELLS. Semiannual Report, 2 July 1969-30 April 1970. (Philco-Ford Corp., Palo Alto, Calif. (USA). Western Development Labs. Div.). 1 Jun 1970. Contract NAS7-100. 54p. (NASA-CR-110885; WDL-TR-4213). NTIS.

For Jet Propulsion Lab., Pasadena, CA.

A summary is presented of a program to experimentally evaluate the real-time degradation characteristics of lithium-diffused silicon solar cells. ^{90}Sr was used for simulation of a typical earth orbital electron environment, both from spectral and flux rate viewpoints. The experiment was performed in an ion pump vacuum chamber with samples maintained at specified temperatures. Samples were illuminated during a six-month exposure run with solar cell 1-5 characteristics measured in situ. The solar cell samples were chosen on the basis of results gained from previous lithium cell development programs. The design of the experimental equipment and the sample matrix are described. (auth)

10954 (N-72-22043) ENGINEERING EXPERIMENTAL PROGRAM ON THE EFFECTS OF NEAR-SPACE RADIATION ON LITHIUM DOPED SOLAR CELLS. Final Report. (Philco-Ford Corp., Palo Alto, Calif. (USA). Western Development Labs. Div.). 10 Nov 1971. Contract NAS7-100. 109p. (NASA-CR-126151; WDL-TR-4725). NTIS.

For Jet Propulsion Lab., Pasadena, CA.

The results of an experimental evaluation of the real-time degradation characteristics of lithium-diffused silicon solar cells are reported. ^{90}Sr was used for simulation of a typical earth-orbital electron environment. The experiment was performed in an ion pump vacuum chamber with samples maintained at -50, +20, +50, and +80°C. Samples were illuminated during the 6-month exposure run with solar cell 1-5 characteristics measured periodically in situ. This 6-month exposure corresponded to a 1 MeV equivalent fluence of approximately 10^{14} electrons/cm^2. Several types of lithium cells were irradiated and compared directly with conventional N/P cells. The best lithium cells compared favorably with N/P cells, particularly at the higher test temperatures. With a slight improvement of initial performance characteristics, lithium cells appear feasible for 5 to 10 y missions at synchronous altitude. Based on the reported results and those of other irradiation experiments, lithium cells would appear to be superior to N/P cells in proton-dominated earth-orbital environments. Another important conclusion of the effort was that illuminated/loaded cells degrade more rapidly than do dark/unloaded cells. The irradiation experiment provided data of high quality with a high degree of confidence because of the experimental and statistical analysis techniques utilized. (auth)

10955 INFLUENCE OF γ RADIATION ON DENSITY OF SURFACE STATES AT THE Si/SiO$_2$ INTERFACE. Kassabov, J. D.; Stoev, I. G.; Kaschieva, S. B. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 1, 19-22(1973).

The effects of γ radiation on fast states localized at the Si/Si0$_2$ interface was studied using the MOS-gated diode structures. The dependence of the reverse current of the p-n junction on the gate electrode voltage was measured before and after irradiation. The relations of the currents I_{MJ}, I_{FSM}, and $I_{F/J}$ before and after irradiation are tabulated for three devices. The ratio of the current I_{MJ}, I_{FSM}, and $I_{F/J}$ is changed after irradiation up to equivalent defect densities of the surface and in the volume, and these defects, created by γ radiation, are annealed at relatively low temperatures. (DLC)

Miscellaneous Instruments

Refer also to abstracts 10637, 10805, 11570, 11579, 11844, and 12494.

10956 (AD-739868) PRECISE MEASUREMENT, REDUCTION, AND DISPLAY OF SPECTROPHOTOMETRIC DATA. Final Report, 1 May 1970-30 June 1971. Trowbridge, C. A.; Bowman, J. C.; Kofsky, I. L. (Photometrics, Inc., Lexington, Mass. (USA)). 31 Jul 1971. Contract F19628-70-C-0260. 34p. (PhM-106-71; AFCRL-71-420). NTIS.

Microdensitometric film reduction, analysis, and display techniques were applied to solar surface radiance and stellar spectral data. Hα photographs of a solar flare event were converted to isophote contour plots, from which brightness solids were measured by planimetry, and radiance profiles, read along selected lines. Solar granulation was observed isophotometrically with two different types of microdensitometric scanner-printer, and density histograms of the granular structure were measured with the aid of a pulse height analyzer. Photographically recorded spectra of the core and outer envelope plasmas of a star were put on magnetic tape in position register for differencing by digital computer. (auth)

10957 (AD-750540) CODA SUPPRESSION CAPABILITIES OF THE BEAM AND MIXED-SIGNAL PROCESSOR. Cohen, T. J. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 30 Aug 1972. Contract F33657-72-C-0009. 61p. (SDL-298). NTIS.

A comparison has been made of the coda attenuation capabilities of the beam and mixed-signal processor using 7- and 19-element TFO subarrays. The major source region was taken as Semipalatinsk (96 degrees distance from TFO), while the interfering signals from various earthquakes were time-shifted to simulate arrivals from various azimuths at 60 degrees distance. (auth)

10958 (AEEW-R-574) DEVELOPMENT OF INSTRUMENTS FOR THE DETECTION OF DRYOUT IN UNIFORM AND NONUNIFORM AXIALLY HEATED ROD CLUSTERS. Adams, D. J.; Salt, K. J.; Wintle, C. A. (Atomic Energy Establishment, Winfrith (England)). Jan 1972. 80p. Dep. NTIS (U.S. Sales Only) $6.00.

Practical problems associated with dryout detection in electrically heated fuel channel simulation experiments are considered, and the details of methods and devices developed in support of the program of heat transfer studies carried out in the Heat Transfer Laboratory at AEE Winfrith are described. (auth)

10959 (NP-19789) SENSITIVITIES OF DIFFERENT TYPES OF CONTINUOUS WAVE NUCLEAR MAGNETIC RESONANCE SPECTROMETERS. Wind, R. A. (Technische Hogeschool, Delft (Netherlands)). 1972. 126p. Dep. NTIS (U. S. Sales Only) $8.50.

Thesis.

Different types of continuous wave spectrometers can be used for the detection of nuclear magnetic resonance, and it is of interest to compare their sensitivities. This has been done in the literature, both in theory and in practice, with contradictory results: sometimes all spectrometers are found to possess the same sensitivity, sometimes these sensitivities are found to be different. However, the experimental results are hardly reliable because in the publications quantities are compared that, in fact, have no relationship to each other. It is the purpose of this thesis to investigate the origin of the theoretical differences, and to compare the different sensitivities experimentally as well as possible. (auth)

10960 (RD/B/N-2646) TELEVISION/STILL CAMERA, WITH COMMON OPTICAL SYSTEM, FOR REACTOR INSPECTION. Hughes, G.; McBane, P. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Mar 1973. 18p. Dep. NTIS (U. S. Sales Only) $3.00.

The design of a remotely operated camera system is described. Continuous television viewing is provided, together with the facility to take still photographs to provide high resolution records. Control of shutter, focus and iris together with measurement of light level can all be achieved remotely. Indication of the film frames used and permanent identification of each frame is also provided. The application of the camera to the inspection of the PFR core region is described. (auth)

10961 (RLO-2227-T-7-22, pp 60-63) PRECISE TIMING METHOD FOR THE DETERMINATION OF SHORT HALF-LIVES. Nunnelley, L. L.; Boynton, W.; Loveland, W. Mar 1973.

In Nuclear chemistry progress report.

10962 HIGH-RESOLUTION NEUTRON TIME-OF-FLIGHT DIFFRACTOMETER. Steichele, E.; Arnold, P. (Univ., Muenchen, Garching, Ger.). Phys. Lett.; 44A: No. 3, 165-166(4 Jun 1973).

The characteristic features of a neutron time-of-flight diffractometer, having a resolution $\Delta d/d \sim 2 \times 10^{-3}$ for powder and single crystal diffraction, are described and some first results are presented. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

10963 (K-L-6316) MONITORING FOR URANIUM ACCUMULATIONS IN DIFFUSION PLANT EQUIPMENT. Taylor, R. G. (Oak Ridge Gaseous Diffusion Plant, Tenn.). 21 May 1973. Contract W-7405-eng-26. 13p. (CONF-730611-8). Dep. NTIS $3.00.

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973).

The enrichment of uranium in a gaseous diffusion cascade is a continuous, repetitive process which requires that multiton quantities of uranium hexafluoride (UF_6) be pumped through process equipment of varying physical size. One of the potential operating problems associated with the process is the inadvertent accumulation in equipment of solid uranium compounds. The events leading to such accumulations are summarized. Techniques employed at the Oak Ridge Gaseous Diffusion Plant for locating uranium depositions using gamma radiation detection equipment and estimating their mass by neutron counting are presented. (auth)

10964 (RFP-2065) POSSIBLE APPLICATIONS OF LASER ISOTOPE SEPARATION TO NUCLEAR AND CONVENTIONAL TECHNOLOGIES. Altschuler, S. J. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). [nd]. Contract AT(29-1)-1106. 13p. (CONF-730611-9). Dep. NTIS $3.00.

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973).

The laser method of isotope separation is discussed in respect to economics and potential large-scale operation. Technical aspects of the method are not included. (TFD)

10965 RELEASE OF FISSION XENON FROM HIGH SURFACE AREA URANIUM TARGETS. McLain, M. E. Atlanta; Georgia Inst. of Tech. (1972). 256p. University Microfilms Order No. 73-6545.

Thesis (Ph. D.).

The ability of the synthetic zeolites (molecular sieves) to absorb uranyl ions was studied and proven suitable for the preparation of high surface-area ^{235}U reactor targets for the simultaneous production and separation of the gaseous fission products. Measured effective diffusion coefficients and activation energy for the ion exchange process from methanol solvent were consistent with data previously reported for similar ion exchange processes. The rate controlling step in the ion exchange of uranyl ion from methanol solutions of uranyl nitrate hexahydrate onto molecular sieve beads was shown to be uranyl ion diffusion through the inter-crystallite space of the beads. The microporous structure of the Type 13X molecular sieves was shown experimentally to release up to 46 percent of the ^{135}Xe fission product from irradiated uranium-loaded material. The rate of release is rapid, but apparently limited by a trapping mechanism. The laboratory data on the release of xenon fission product gases from uranium-loaded synthetic zeolites was applied to the design of a prototype reactor loop apparatus for the continuous production of ^{135}Xe. This prototype, constructed, installed, and operated at a thermal neutron flux of 5.45×10^{11} nv, produced 150 millicuries of ^{135}Xe per 14 hours of reactor operation. Self-heating was the limiting factor in ^{135}Xe production in the prototype apparatus. (RWR)

Radiation Sources

Refer also to abstract 11076.

10966 (BNWL-1686) TECHNICAL, ECONOMIC, AND POLICY CONSIDERATIONS AFFECTING FUTURE PRODUCTION, MARKETING, AND USE OF CESIUM-137 AND STRONTIUM-90. McKee, R. W. (Battelle Pacific Northwest Labs., Richland, Wash.). Dec 1972. Contract AT(45-1)-1830. 347p. Dep. NTIS $3.00.

An analysis and evaluation are presented of the technical, economic, and market factors relevant to the future separation and distribution of fission-product cesium-137 and strontium-90 by the AEC and, subsequently, by private nuclear fuel processors and the policy alternatives available to the AEC as these affect and are affected by market considerations and potential private participation. The study addressed itself to the following major considerations: (1) the time, cost and economic feasibility of cesium-137 and strontium-90 separation and marketing by private nuclear fuel reprocessors; (2) the basic value of cesium-137 and strontium-90, relative to their competitors and their current, developing, and envisioned applications; (3) the compatibility of the fuel reprocessors' price requirements for cesium-134/137 and strontium-90 with the basic values of those products in the marketplace; (4) the historical, current, and projected markets for cesium-137 and strontium-90 in relation to the feasibility of private fission-product separation plants; (5) the technical applications, suitability, and required pricing for the cesium-137 and strontium-90 encapsulated sources to be produced under the AEC waste management program at Hanford; and (6) the options available to the private nuclear fuel reprocessors with respect to entry into the fission product separations and distribution market; also, the options available to the AEC concerning the interim availability and pricing of the waste management sources and the interrelationship between these respective options. The principal conclusions of the study were: (1) steady market growth can be anticipated for both cesium-137 and strontium-90 if they are priced at levels compatible with market requirements. The market for cesium is a share of the gamma source market currently supplied almost exclusively by cobalt-60. The principal market for strontium is the U.S. Navy for devices needing remote power sources; (2) private separation and marketing of fission-product cesium-137 and strontium-90 in the late 1970's or early 1980's by nuclear fuel reprocessors is well within the realm of economic feasibility. However, the visible market will have to be substantially larger than current markets to permit pricing at levels compatible with market requirements; (3) by marketing the Hanford waste management cesium-137 and strontium-90 capsules and establishing a market, the AEC is in a position to enhance the prospect for later recovery and utilization of these materials as nuclear power by-products; (4) prices can be established for the waste management capsules that are compatible with market requirements, consistent with the reprocessors later price requirements, and in accord with the AEC full cost recovery policy; (5) several options are available to the AEC in methods for marketing the waste management capsules. For example, lower prices can be offered for large purchases, and special cesium capsules with hollow inserts or reduced diameter can be produced that will enhance the value of the contained cesium-137; and (6) even if no significant market should develop, the AEC is assuming no economic risk in offering the waste management sources for sale at prices consistent with market requirements and its own full cost recovery policy. (RCK)

10967 (STI/PUB-314) NUCLEAR TECHNIQUES IN THE BASIC METAL INDUSTRIES. Proceedings Series. Proceedings of a Symposium Held in Helsinki, Finland, July 31–August 4, 1972. (International Atomic Energy Agency, Vienna (Austria)). Mar 1973. 643p. (In Several Languages). (CONF-720704-). IAEA $24.00.

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972).

Separate abstracts were prepared for 33 of the 36 papers presented. The remaining 3 papers were previously included in NSA and can be found in the Report No. Index under CONF-720704. (WHK)

For abstracts of individual papers see: 10641–10643, 10668–10670, 10809, 10930, 10940–10950, 10968, 10971–10981, 11257, and 11258.

10968 PRELIMINARY SURVEY OF POTENTIAL AREAS FOR APPLICATIONS OF NUCLEAR TECHNIQUES IN THE BASIC METAL INDUSTRIES IN DEVELOPING COUNTRIES. Glebov, S. N. pp 93-102 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704–.

After a summary of UNIDO's functions and activities, a brief description is given of the iron and steel and the non-ferrous industries in the developing countries. Collaboration between UNIDO and IAEA on the introduction of nuclear techniques in the basic metal industries of these countries is discussed. (auth)

Industrial Uses

Refer also to abstracts 10641, 10642, 10998, 10999, 11027, 11844, and 12076.

10969 (STI/DOC-59) REPORT OF A CONSULTATION GROUP ON THE LEGAL ASPECTS OF FOOD IRRADIATION. (International Atomic Energy Agency, Vienna (Austria)). 1973. 30p. IAEA $3.50.

The legal aspects of international trade in irradiated food are examined. Several conclusions and recommendations are presented that may provide some general guidance in the development of regulations concerning irradiated foods. A review of existing legislation on food irradiation in member states is given. (TFD)

10970 (TID-26341) POTENTIAL FOR THE USE OF COBALT-60 IRRADIATION IN THE TREATMENT OF WASTEWATERS. Okun, D. A. (North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering). Jun 1973. Contract AT(07-2)-1. 33p. Dep. NTIS $4.00.

This report, to evaluate the potential for the use of ^{60}Co irradiation in the treatment of wastewaters, is based primarily on a review of the literature in the field. Possible potential for ^{60}Co is in the degradation of organic pollutants and refractory chemicals in wastewaters, improvement in the settling characteristics of solids in wastewaters, improvement in the handling of wastewater sludges, and in the disinfection of wastewaters and sludges. ^{60}Co irradiation is not very effective in the degradation of pollutants, except for certain specific industrial wastes, and has only a limited impact on the settling characteristics of wastewater solids. It is effective in disinfection of wastewaters. However, even where radiation is effective, the costs for treating wastewaters by irradiation are likely to be far too high to be competitive with other processes that are already available. ^{60}Co irradiation may be economically feasible for sludge treatment because sludge is more concentrated than wastewater. However, the benefits in sludge handling are not likely to be attractive because alternative methods are more acceptable and economical. The greatest potential is for sludge disinfection, but sludge disinfection is not, nor is it expected to be, widely adopted. Further research in the use of irradiation is not likely to result in large-scale use of ^{60}Co in the water pollution control field. (auth)

10971 APPLICATION OF RADIOISOTOPES IN THE ALUMINIUM INDUSTRY IN JAPAN. Kato, M. (Tokyo Univ.); Hirayama, T.; Nishimura, K.; Tomohiro, I.; Watanabe, H.; Tsurumaki, K.; Showa Denko, K. K. pp 37-48 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

In the aluminium industry, the capacity of the manufacturing facilities has been enlarged in recent years owing to increased demand and production. Radioisotopes are used as a research tool and as a means of process control because of their wide applicability ranging from basic research to industrial processes. The processes involved in aluminium production can be divided into three: the Bayer process, the reduction process and the fabrication process. In the Bayer process various experiments have been made for using tracers to analyse the residence time, the mixing, and the flow pattern. In the reduction process, tracers have been used for measuring the amount of liquid aluminium in the cells and for studying the current efficiency. Owing to a large increase in the electric current as a result of the enlargement of facilities, the aluminium surface lacks horizontal flatness. The tracer method using titanium capsules has been tried in order to separate the aluminium flow from diffusion. Penetration of bath material into the cathode carbon of the cell has been observed by using activable tracers, autoradiography and the electron probe microanalyser (EPMA) method. In consequence, it has been learned that sodium preferentially penetrates into the cathode carbon and then the electrolytic bath penetrates into it. In the fabrication process, many tracers have been used to detect impurities in the aluminium and in studies on dispersion, surface and corrosion phenomena. In addition, autoradiographic and activable tracer techniques have been used in the considerable amount of research and development work that has been done. Radioisotopes have also been applied in the whole field of analytical work related to the aluminium industry. For example, study is being made of the use of a 14-MeV neutron generator in the analysis of oxygen in aluminium and aluminium alloys, and in the simultaneous analysis of aluminium, oxygen and fluorine in the electrolytic bath. Also, attempts have been made to apply radioisotopes for process control, in combination with other analytical methods. The application of radioisotopes in the aluminium industry are introduced and summarized, and typical examples of their uses in Japan are reviewed. (auth)

10972 TRACER TESTING OF PARTICULATE MATTER SYSTEMS FOR THEIR DYNAMICS. Niemi, A. (Helsinki Univ. of Tech., Otaniemi). pp 131-140 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

The methodology of tracer testing with granular material was developed during studies of metallurgical processes, especially of industrial flotation. The characteristics of the process under study determine the choice of the tracer compound which usually is a selected component of the process material. The amount of material to be activated depends on the distribution of particle size. An application to compounds with ^{59}Fe as the nuclide to be traced is presented. The required activity depends on flow characteristics, i.e., on the estimated dilution in the process. Before injection, a special preparation of the tracer batch may be required. The samples to be measured are fairly large, and, for measurements by size ranges, they have to be screened. The volumetric weight is liable to change from sample to sample, and corrective measures or special techniques must be applied in order to attain uniform conditions of measurement. The tracer test reproduces the kinetic effects of the process in linearized form. With some trouble, large single particles can be separated from the samples for an analysis of the progress of reaction. However, kinetic information needed for an expansion of the dynamic model is normally acquired by other means. Residence-time distribution function or the response of the process to a concentration impulse is fitted to dynamic, analytical models, by such methods as that of least squares. Irrespective of the form of presentation, the resulting weighting function can be used for calculating the output through a convolution integral. Under changing flow conditions, a time-variable weighting function results, and its relation to modern control theory is discussed. A new residence variable is defined so that the weighting function is invariant with regard to this quantity. It is explained how the weighting function is determined and utilized, while the flow is changing simultaneously, and how the functions established for constant flow conditions are adapted to flow changes. (auth)

10973 TRACER METHODS USED IN THE DETERMINATION OF RAW MATERIALS MIXING HOMOGENEITY IN IRON SINTERING PLANTS AND OF CHEMICAL ELEMENTS BALANCE IN METALLURGICAL PROCESSES. Michalik, J. S.; Bazaniak, Z.; Palige, J.; Swigon, K.; Radwan, M. (Inst. of Nuclear Research, Swierk, Poland). pp 205-219 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

During the last twelve years or so, and particularly in the most recent period, a wide range of work on the development of tracer methods and their practical use in metallurgical technologies has been done in Poland. Tracer methods have been developed and put into practice for investigating the homogeneity of raw materials and the mixing efficiency in iron sintering plants. Special equipment for the continuous labelling of large quantities of granular materials using an aqueous solution of radioactive lanthanum has been constructed. The statistical elaboration of the results of radiometric measurements have permitted the degree of mixture at given characteristic points in sintering plants to be calculated. The original tracer method for balancing the elements involved in metallurgical processes has been further developed and has been applied in extensive investigations of the behaviour of sulphur and phosphorus in the continuous luppen-iron process and of the behavior of sulphur and chromium in the open-hearth process. These developments are discussed both from a technological and theoretical viewpoint. (auth)

10974 STUDY OF THE DEOXIDATION MECHANISMS IN A STIRRED STEELBATH USING RADIOACTIVE ISOTOPES. Lindskog, N. (Royal Inst. of Tech., Stockholm). pp 221-226 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

Liquid pure iron containing about 1000 ppM oxygen has been deoxidized with 0.5% radioactive silicon in an HF induction furnace using SiO_2 and Al_2O_3 crucibles. The distribution of radioactivity in the crucible wall was determined by a scintillation detector. For the SiO_2-crucible 25% of the radioactivity was found in the slag-line, 70% on the crucible wall below the slag-line and 5% in the bottom of the crucible. For the Al_2O_3 crucible the corresponding values were: 15%, 75%, and 10%. These results support the assumption that most of the deoxidation products in a stirred steelbath are removed by adsorption on the crucible wall. This may change the models for the removal of deoxidation products we have today. (auth)

10975 USE OF ACTIVATED PROCESS MATERIALS AS TRACERS IN SMELTER PROCESS STUDIES. Kuoppamaki, R. (Tech-

nical Research Centre of Finland, Otaniemi); Kuusi, J.; Blomqvist, S. pp 227-236 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

In tracer studies the choice of tracer is of great importance, especially when the material to be traced is solid and its behaviour is greatly dependent on its physical properties, such as density, grain size, rigidness, etc. In many cases an ideal radioisotope tracer can be produced by irradiating the process material with neutrons of a nuclear reactor. A suitable choice of irradiation parameters and the use of energy-selective measuring techniques makes it possible, within certain limits, to trace various components of the process material separately. Two process studies in a ferrochrome smelter in which activated process materials were used as tracers are described. To gain statistically representative results on the behaviour of the process materials it was necessary to irradiate quite large amounts of material up to 6 kg. In the first study the residence-time distributions for the five input materials of the melting process, chrome concentrate pellets, lump, ore, coke, dolomite and quartz, in the preheating (rotary) kiln, were measured one at a time. The results revealed differences in the average velocity of these materials in the kiln caused by their different physical properties. In the second study the residence-time distribution for both chromium and slag-forming components in the electric melting furnace were measured simultaneoulsy. Irradiated chrome concentrate pellets with induced ^{51}Cr radioisotope were used as a tracer for chromium, and irradiated coke impregnated by lanthanum solution and dried before irradiation, producing ^{140}La radioisotope, was the tracer for the latter. The characteristics of the residence-time distributions of chromium and slag-forming components differed to a certain extent. Owing to the successful selection of the tracers the results of the studies provided very valuable and detailed information on the time behaviour of the process for process control purposes, and provided the basis for the construction of the process model. (auth)

10976 RADIOISOTOPE INVESTIGATIONS OF THE CONTINUOUS CASTING OF STEEL. Siewierski, J.; Kolaski, H.; Firganek, H.; Labus, J.; Wieczorek, E. (Inst. of Ferrous Metallurgy, Gliwice, Poland). pp 237-250 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-620704-.

The investigations, undertaken with the aim of obtaining maximum output in the continuous casting process and improving surface quality of the billets, were concerned with the effects of process and mould parameters on the behaviour of the crystallization front and with the determination of the origin of surface non-metallic inclusions, which affect adversely the quality of continuous billets. The first part of the work was concerned with crystallization of continuous billets. The experiments were carried out in three different industrial machines casting 100 to 160 mm square carbon and alloy steel billets. Phosphorus-32 in the form of red phosphorus was used as the tracer. Autoradiographic examination of the billets provided information on the operation of the mould and secondary cooling section and the results were used to recommend a safe depth of liquid zone and a limiting casting speed with respect to the danger of rupture of the solid skin of billets under the mould. The effects of casting speed and primary cooling on the shape of crystallization front were also determined. The second part of the work was concerned with the determination of the origin of non-metallic inclusions present on the surface of continuous billets. The experiments covered the following potential sources of such inclusions: tundish slag, fireclay refractory used for patching of the tundish, and tundish nozzle refractory. Non-radioactive tracers were used in this case and in each test the concentration of materials originating from two sources were determined in the inclusions. The non-radioactive tracers were: lanthanum oxide, which was added to the slag or fireclay refractory, and hafnium silicate, which was a natural component of the zirconium insert in the tundish nozzle. The neutron activation method was used for determining the tracer materials. It was found that the tundish slag, the zirconium nozzle insert, and the fireclay patching material were not the principal sources of the surface inclusions. The presence of these materials in the inclusions was accidental and was not affected by duration of casting, size and type of inclusion, and its location on the surface of billets. Nozzle material concentrations were generally higher in inclusions with higher tundish slag contents. This might indicate a corrosive action of the slag on the zirconium inserts. (auth)

10977 DETERMINATION OF FLOW CHARACTERISTICS FOR A CONTINUOUS SLAG-METAL REACTOR USING MEASUREMENTS OF RESIDENCE-TIME DISTRIBUTION AND CONCENTRATION GRADIENT. Engh, T. A. (Technical Univ. of Norway, Trondheim); Hansson, L.; Ljunggren, K. pp 251-264 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

Various continuous steel-making processes are being developed around the world. One of these is the WORCRA process with steel and slag in counter-current gravity flow. The flow in the slag phase has been experimentally investigated by means of measurements of the residence-time distribution, using ^{140}La as a tracer, and of the phosphorus concentration gradients in the slag and steel phases. A method is presented for the evaluation of these measurements and for the determination of the boundary conditions under the assumption that the refiner may be regarded as one-dimensional. (auth)

10978 STUDY OF THE SURFACE FILM OF TIN-FREE STEEL SHEET BY USING THE RADIOISOTOPE TRACER TECHNIQUE. Iijima, H. (Nippon Kokan Kabushiki Kaisha, Kawasaki, Japan). pp 355-367 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

Recently, Tin-Free Steel Sheet (TFS), i.e., steel sheet that is treated in electrolytic chromic acid solution, has been developed as a substitute surface-treated steel sheet for tin plate, and its excellent surface property has been appreciated. Since the structure and properties of the surface film, however, had not been studied in detail, the author carried out investigations by using the radioisotope tracer technique; i.e., noting that Cr and S are the essential elements in the electrolytic chromic acid solution and in the surface film, and labelling the electrolytic solution with ^{51}Cr or ^{35}S, then generating the surface film at various electrolytic conditions, the author analysed the distribution and behaviour of ^{51}Cr or ^{35}S in the surface film. The results can be summarized as follows: (1) It was confirmed that the surface film of TFS forms the peculiar double layer structure; (2) The speed of formation of the Cr hydroxide layer is quite different from that of the metallic Cr layer during the electrolytic treatment; (3) The relation between the electrolytic conditions and the distribution of Cr or S in the surface film, as well as the behaviour of these elements, was clarified; (4) The relation between the electrolytic current density and the content of S compounds in the Cr hydroxide layer was clarified by the autoradiograph technique; and (5) It was confirmed that the undesirable S compounds in the surface film can be markedly decreased by the addition of HBF_4 into the electrolytic solution. (auth)

10979 QUALITY CONTROL OF ROLLED SANDWICH PLATES AND CO-EXTRUDED TUBES. De Meester, P. J. A. (Katholieke Univ.; Leuven, Heverlee, Belgium). pp 405-425 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB/-314; CONF-720704-.

The rolling of picture-frame sandwich plates is qualitatively analysed. Several phenomena concerning metal flow in the roll gap observed in such plates are discussed and the divergences from rolling practice for homogeneous plates are considered. The quality of rolled sandwich plates can be evaluated by the "sandwich-rollability index" (SRI) and "dog-boning index" (DBI). These parameters can be calculated from measurements using radioisotopes, either as an external source, or as a tracer in the sandwich plate itself. Recordings with a ^{170}Tm source are compared with classical radiography. Tracer techniques with activated iron and copper have permitted the use of the same technique for evaluating homogeneous plate rolling. An adaptation of these techniques is also described for the evaluation of co-extruded tubes. (auth)

10980 NEW MICROAUTORADIOGRAPHY USING AUGER ELECTRONS IN THE STUDY OF THE STRUCTURE AND PITTING CORROSION OF ALUMINIUM. Kato, M.; Inoue, T.; Sato, O. (Tokyo Univ.). pp 541-556 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

There are quite a number of radioisotopes among metal elements which emit Auger electrons and internal conversion electrons. These electrons are very short in their ranges in nuclear emulsion

as well as metals, i.e. less than 1 μm. Thus, when autoradiography can be performed using these electrons, autoradiographs of very high resolution can be obtained. Iron-55, which emits K x-rays of 5.9 keV, about 70% of which convert into Auger electrons, was used to study the distribution of iron in aluminium and to study the influence of intermetallic compounds (mainly Al_3Fe) on the pitting corrosion of aluminium. In the first study, ^{55}Fe was incorporated into high-purity aluminium and Al-Fe alloy samples containing from 0.008 to 0.09% Fe were prepared. These samples were then heat-treated in various ways and, after polishing, autoradiographs were made. Results indicated that the range of the Auger electron was up to about 0.3 μm and its blackening response was excellent where the K x-ray responded little. Also, from these high-resolution autoradiographs it was possible to observe the behaviour of iron in aluminium. In the second study, the same alloys were rolled and heat-treated, and then the specimens for the corrosion test and autoradiographic examination were prepared. They were exposed in a corrosive environment, and subsequently autoradiographs were made. Results indicated that many tiny blackening spots in autoradiographs appeared at the same positions as the circumference of pits and, from this, that Fe ions dissolved from the interior of pits precipitated on the local cathodic parts of the circumference of pits. Further, from the results of the microscopic observation, blackenings of autoradiographs were seen right at the centre of pits. This indicated that the intermetallic compounds, Al_3Fe, $FeSi_2Al_4$ and $Fe_2Si_2Al_9$, play an important role in causing the pitting corrosion of aluminium. (auth)

10981 RADIOGENIC ^{187}Os IN METALLURGICAL PRODUCTS AS RHENIUM INDICATOR. Meier, H.; Unger, E.; Albrecht, W.; Bosche, D.; Zeitler, G.; Hecker, W.; Menge, P.; Zimmerhackl, E. (Staatliches Forschungsinstitut feur Geochemie, Bamberg, Ger.). pp 611-622 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

An experiment is described in which ^{187}Os formed during the reaction $^{187}_{75}Re \rightarrow {}^{187}_{76}Os + \beta^-$ is used as a tracer for rhenium. It is shown that, in a metallurgical product obtained during the processing of Pu-Cu-concentrates, radiogenic ^{187}Os could be extracted in the amount of grams. The normal isotope abundance of ^{187}Os is 1.64%; the ^{187}Os found here is more than 80%. From this observation it could be concluded that the ores used had an interesting content of rhenium. The reason for the applicability of radiogenic osmium as a natural tracer is discussed. The authors stress that this tracer can be considered as a model exemplifying the use of small amounts of radiogenic nuclides and, similarly, radionuclides in the study of enrichment processes that occur during industrial metallurgical operations. (auth)

LIFE SCIENCES

10982 (BNWL-1750(Pt. 2)) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1972 TO THE USAEC DIVISION OF BIOMEDICAL AND ENVIRONMENTAL RESEARCH. Volume I. Life Sciences. Part 2. Ecological Sciences. Vaughn, B. E. (Battelle Pacific Northwest Labs., Richland, Wash.). Mar 1973. Contract AT(45-1)-1830. 136p. Dep. NTIS $3.00.

Separate abstracts were prepared for 55 sections of this report. (CH)

For abstracts of individual sections see: 10851, 10852, 10855, 10856, 10877, 10883, 10896-10901, 11044, 11045, 11081, 11088, 11092, 11106-11108, and 12500-12534.

Radiation Effects on Biochemicals

10983 (COO-3125-1) PHOTOREACTIVATION AND DARK REPAIR AND THEIR EVOLUTIONARY ASPECTS. Kelner, A. (Brandeis Univ., Waltham, Mass.). 1973. Contract AT(11-1)-3125. 36p. Dep. NTIS $4.00.

A theoretical consideration is presented of the relationship between DNA repair (photoreactivation and dark repair) and other areas of biology, with emphasis on evolution. The discussion includes: a suggested modification of some details of theories of the origin of life, and early stages of evolution, to take account of the extreme vulnerability of DNA to uv light in the absence of repair; an analysis of the environment of early photosynthetic organisms (before full development of the ozone layer) as one particularly favorable for evolution of repair mechanisms; the reasons why evolution of both DNA and repair are probably closely related; and the reasons why from evolutionary theory, the photoreactivating enzyme is probably not a vestigial enzyme in the higher organisms possessing it (such as marsupials) but has some essential function besides photoreactivation, preserving it from extinction. Other general biological and medical and social aspects are also discussed. (auth)

10984 (ORO-3630-15) PHOTOREPAIR OF UV DAMAGE TO DNA: STUDIES WITH THE DNA-PHOTOREACTIVATING ENZYME. Three year summary, January 2, 1970-April 31, 1973. Werbin, H. (Texas Univ., Dallas (USA). Inst. for Molecular Biology). [nd]. Contract AT(40-1)-3630. 20p. Dep. NTIS $3.00.

The role of DNA-photolyase in the enzymatic photoreactivation of uv-irradiated DNA is being investigated. Results of investigations of the molecular basis for its action and its ecological significance are briefly discussed. (ERB)

10985 (ORO-3630-16) PHOTOREPAIR OF UV DAMAGE TO DNA: PURIFICATION AND PROPERTIES OF THE DNA PHOTOLYASE (THE DNA-PHOTOREACTIVATING ENZYME). Progress Report, January 2, 1972-April 1973. Werbin, H. (Texas Univ., Dallas (USA). Inst. for Molecular Biology). [nd]. Contract AT(40-1)-3630. 9p. Dep. NTIS $3.00.

It is well-known that DNA-protein complexes such as that between lac operator and repressor can be trapped on nitrocellulose filters. The complex formed in the dark between DNA-photolyase and irradiated ^{3}H-T7 phage DNA can be trapped the same way. If the complex is photoreactivated, the labeled DNA passes through the filter. Based on these observations, a new and rapid assay was devised to measure photolyase. The assay permits the molar concentration and the percent purity of the enzyme to be calculated and it is this parameter, rather than the usual specific activity that is used to follow enzyme purification. With data from the new assay, Lineweaver-Burk plots of 1/v, the reciprocal of cpm T7 DNA bound, versus the number of dipyrimidines per genome, 1/s, permitted calculation of the association constant for complex formation, 2.63 cyclobutadipyrimidines per genome (T7), for the yeast photolyase. The new method is useful for rapid screening of column eluates for the enzyme. Because the membrane binding technique physically separates complex formation in the dark from the photolytic step, one can determine which amino acid residues in the enzyme are involved in binding to irradiated DNA. Ferricyanide oxidation inhibits binding, but this was partially reversible when the enzyme was dialyzed against 2-mercaptoethanol. That a cysteine residue may have been attached was supported by the almost complete loss of binding after the enzyme was treated with p-chloromercuribenzoate. (auth)

10986 MAMMALIAN CELLS: NORMAL AND DEFICIENT IN EXCISION REPAIR SYSTEMS. Zasukhina, G. D.; Andzhaparidze, O. G. (Moscow Inst. of Viral Preparations). Acta Virol. (Prague) Engl. Ed.; 16: 509(Nov 1972).

Normal skin cells and fibroblasts from patients with Xeroderma pigmentosum were previously used in studies on repair of uv-damaged DNA of 5V40 and Herpes simplex virus. Repair of viral DNA was studied using chick embryo cells, pig embryo cells, hamster kidney cells, and human diploid cells transformed by leukemia-like oncornavirus. A table is presented to show results of thymine dimer excision in the different cell lines. (HLW)

10987 ERGOSTEROL PHOTOISOMERIZATION REACTION SCHEME. Mermet-Bouvier, R.; Abillon, E. (CEN de Saclay, Gif sur-Yvette, France). J. Pharm. Sci.; 62: No. 6, 891-894(Jun 1973).

The kinetics of the various isomers formed at low temperature by uv irradiation of ergosterol were studied experimentally at the wavelength $\lambda = 253.7$ nm. The characteristics of the photostationary state were used to determine the isomer precursor of the toxisterols as well as the quantum transformation yields of one isomer into another. (auth)

10988 RADIATION DAMAGE TO THE RENATURATION CAPACITY OF DNA CAUSED BY THE EFFECT OF PROTONS, HEAVY IONS, AND GAMMA-RAYS. Marinova, Ts. I.; Petrova, S. N.; Govorun, R. D.; Ryuzhev, N. I.; Grigor'ev, Yu. G.; Todorov, S. L. (Research Inst. of Medical Biological Problems, Moscow). Sci. Pub., Res. Inst. Radiol. Radiat. Hyg.; 4: 57-61(1968).

The effects of heavy ions, protons, and gamma rays on the renaturation capacity of DNA irradiated in the denatured state were studied. Specifically, the radiation dose impairing the capability of the single-strand DNA for complement fixation was established. It was found that low radiation doses, producing lesions along the phosphoro-ester links did not affect the renaturation capacity while higher doses, causing destruction of the nucleic acid bases, did render impossible the complementary linkage of the DNA chains. (ERB)

10989 STUDY OF UV-TREATED BU-DNA: BEARING ON ITS CAPACITY TO FORM HYBRIDS WITH FAST-LABELLED RNA. Dacheva, M. A. Sci. Pub., Res. Inst. Radiol. Radiat. Hyg.; 4: 63-67(1968).

The effects of uv irradiation in vitro on the complementary qualities of 5-bromo-uracil-labeled DNA were studied. The criterion used was its capacity to form hybrids with fast-labeled RNA of the same bacterial strain. The results indicated that 5-bromo-uracil-labeled DNA was more radiosensitive than normal DNA: it proved the presence of a direct radiosensitizing effect of bromouracil. (ERB)

Radiation Effects on Cells

10990 (LBL-2001) CYTOGENETICS AND FANCONI'S ANEMIA: EXPERIMENTAL AND OTHER STUDIES OF A FAMILY. Loughman, W. D. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-eng-48. 221p. Dep. NTIS $13.25.

Thesis.

The genetic and cytogenetic literature pertaining to Fanconi's Anemia (FA) is reviewed. Physical and clinical data are given for a case of FA, her living family, and three deceased FA sibs. A pedigree of 188 individuals in 7 generations is discussed. Experimental studies during 5.5 years from diagnosis to termination of treatment are reported. FA bone marrow cells contained no chromosome abnormalities. Cultured FA lymphocytes contained chromatid exchanges, gaps, and breaks, with multicentric chromosomes but virtually no other aberrations. Lymphocyte chromosome repair time during G_1 was measured in all family members; all were approximately 4 hours as in controls. The results in the FA case suggested an extreme dispersion of repair times, or the existence of multiple cell populations. X-ray induced aberration rates during the first G_1 and the last G_2 of cultured lymphocytes were the same as controls in all subjects' cells. (CH)

10991 RADIOBIOLOGICAL EFFECTS OF SOLELY NUCLEAR AND CYTOPLASMIC IRRADIATION WITH ULTRAVIOLET MICROBEAM IN HeLa CELLS. Usui, M. (Mie Prefecture Univ., Tsu, Japan). Mie Med. J.; 20: No. 1, 21-37(1970).

Three modes of uv-microbeam irradiation, solely nuclear, cytoplasmic, and whole-cell irradiation were used to study the mechanism of radiation damage in HeLa cells. Experiments on micrurgical cytoplasmic damage were conducted as controls. In solely nuclear irradiation, a sudden cytoplasmic shrinkage caused cell

billing after several hours in a stationary state, with or without morphological findings of slight degeneration. Gradual and lethal development of vascular degeneration was induced by solely cytoplasmic irradiation. Either the former or the latter type of effect was induced by whole-cell irradiation. The lethal effects of nuclear irradiation over a 24-hr period were induced rapidly and intensively in the order of whole-cell greater than solely cytoplasmic. Whole-cell irradiation inhibited DNA and RNA synthesis more rapidly than solely nuclear irradiation. The inhibitory effects of solely cytoplasmic irradiation were less than by the other two methods. Whole-cell irradiation inhibited RNA transport only at high doses, but partial irradiation of the Golgi body had no effect at the same high doses. Micrurgical cytoplasmic damage was reparable for 24 hrs when a part of the cytoplasm did not exceed about 40% of the reflected area of the whole cell. Possible mechanisms of this discrepancy in the data on survival rates and inhibitory rates of nucleic acid synthesis between solely nuclear and cytoplasmic irradiation are discussed. (ERB)

10992 CYTOGENETIC EFFECT OF COMBINED ACTION OF X-RAYS AND THIO-TEPA ON HUMAN EMBRYONIC CELL CULTURE. Korotkikh, I. M.; Tarasov, V. A.; Myasova, Z. N. (Inst. of General Genetics, Moscow). Genetika; 9: No. 4, 101-106(Apr 1973). (In Russian).

Combined effect of thio-TEPA and x rays at different doses (25, 50, and 100 R) on cells of human embryos was studied. It appeared that the cytogenetic effect of combined action of the mutagens at doses of 50 and 100 R exceeded significantly the total level of mutability of each separate mutagen. At the dose of 25 R, the treatment with thio-TEPA and x rays led to a decrease in the frequency of chromosome aberrations as compared with the additive level. The differences in the reaction of cells, simultaneously treated with the mutagens, when x rays were used at low (25 R) and relatively high doses (50 and 100 R), might be due to the effect of thio-TEPA at least at two stages of the general multistaged process of realization of induced mutational changes. (auth)

10993 STUDY OF THE INTENSITY OF UV FLUORESCENE OF THE BONE MARROW CELLS CULTURED IN DIFFUSION CHAMBERS. Galustyan, A. Sh.; Safronova, V. G. (Central Research Inst. of Roentgenology and Radiology, Leningrad). Tsitologiya; 15: No. 3, 456-461(Apr 1973). (In Russian).

The increase of the intensity of uv fluorescence of the bone marrow cells after total irradiation with 450 rads of x rays was stable, and was traced under conditions of explantation in irradiated organisms. During 6 months, this effect is clearly shown persisting for a long period in the cultures of nonirradiated bone marrow under the influence of the diffusing humoral factors of the irradiated recepient. The defect of the processes of proliferation and differentiation of the hemopoietic elements was found, according to the intensity of uv fluorescence, in remote periods after irradiation (6 months) in the conditions of explantation, regarded as a special kind of functional loading. (auth)

Radiation Effects on Microorganisms

10994 INDUCED MUTAGENESIS IN STRAINS OF CHLORELLA VULGARIS DIFFERING IN THEIR RADIOSENSITIVITY. Ozol, A. A. (Inst. of Marine Biology, Vladivostok, USSR). Genetika; 9: No. 4, 39-48(Apr 1973). (In Russian).

Frequency of mutations induced by uv rays and x rays was studied in a wild strain of Chlorella vulgaris and in three uv-sensitive mutants. The mutants exhibited a higher frequency of pigment mutations, both complete and sectorial, as compared to the wild strain. No induced mutations in any experiment were observed in none of the mutants. UV-induction of mutations to alanine-resistance was observed in the wild strain and in one of the uv-sensitive strains. The results obtained suggest that there exist several systems of recovery from radioinduced lesions participating both in the initiation of mutations and in the recovery from pre-mutational lesions in Chlorella. (auth)

10995 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 14: No. 5, 298-312(May 1973).

Data are presented on the concentration of the beta sources in surface air and precipitation samples collected at selected sites throughout the United States and Canada during January 1973. Data are also presented on the concentration of beta sources in surface air samples collected at selected sites in Arizona, California, Nevada, and Utah and in Central and South America during January 1973. The Health and Safety Laboratory-80th Meridian Network is a series of surface air sampling stations. From this network comes data on the concentrations of ^{89}Sr, ^{90}Sr, ^{95}Zr, ^{137}Cs, ^{144}Ce, ^{238}Pu, and ^{239}Pu in surface air samples collected during January to December 1970 (monthly averages). (ERB)

10996 DIFFUSION OF OXYGEN IN BACTERIAL CELLS AFTER EXPOSURE TO HIGH-INTENSITY PULSED ELECTRONS; THEORETICAL MODEL AND COMPARISON WITH EXPERIMENT. Kessaris, N. D.; Weiss, H.; Epp, E. R. (Sloan Kettering Inst. for Cancer Research, New York). Radiat. Res.; 54: No. 2, 181-191 (May 1973).

A biophysical model was proposed in order to explain and predict the behavior of oxygen diffusion in bacterial cells after they have been rendered anoxic by a high intensity pulse of electrons. The model postulates the existence of a set of agents created by the radiation that slowly react with the diffusing oxygen. In so doing, the agents are neutralized and the oxygen molecules are prevented from reoxygenating the cells. The result is a transient absorption. The calculated oxygen concentration obtained from a modified diffusion equation gives adequate to good agreement with experiment. The model as applied to the experimental data yields numerical values for all physical parameters involved: the cellular diffusion coefficient, the interaction cross section, and the initial concentration of the oxygen-reacting agents. A nontrivial dependence of oxygen diffusion on dose and saturation oxygen concentration is also predicted. (auth)

10997 EXCISION REPAIR OF ULTRAVIOLET RADIATION DAMAGE IN TOLUENE TREATED ESCHERICHIA COLI. Segev, N.; Miller, C.; Sharon, R.; Ben-Ishai, R. (Israel Inst. of Tech., Haifa). Biochem. Biophys. Res. Commun.; 52: No. 4, 1241-1245 (19 Jun 1973).

ATP independent excision repair of uv damage was studied in E. coli made permeable to nucleotides by treatment with toluene. In using this system, separation of the first step from the subsequent steps in the repair process is achieved. Completion of repair is observed only in strains that have normal levels of DNA polymerase I. (auth)

10998 RADIATION EFFECTS ON FOOD. Number 12. Gruenewalt, T.; Strahlmann, B. (comps.). Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 48p. (In German).

This bibliography on food irradiation covers predominantly publications of the years 1970 and 1971, but also some earlier publications in the following fields: Basics of food irradiation (technology and irradiation devices, dosimetry, economic and legal aspects), wholesomeness and other medical problems and animal feeding studies, chemical and biochemical reactions and the effect of ionizing radiation on the nutritional quality of foodstuffs, irradiation effects on microorganisms, applications at higher and low dose levels and combined methods for disinfestation, increase of shelf-life, radurization, radappertization, and radicidation of fruit and vegetables, spices, milk and dairy products, meat and poultry, as well as fish and fish products, cereals, flour, and baked goods, ready prepared meals, and feedstuffs. All publications contained in the bibliography are available from the Bundesforsch ungsanstalt fuer Lebensmittelfrischhaltung and from the Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED) in Karlsruhe. The bibliographical part of the issue is complemented by an author and a subject index. (GE)

10999 RADIO-STERILIZATION OF THE BULGARIAN PLASMA EXPANDER HAEMODEX. Keslev, D. D.; Ovcharov, R.; Todorov, S. L.; Cholakova, G. Sci. Pub., Res. Inst. Radiol. Radiat. Hyg.; 4: 79-83(1968).

The applied dose of 2.5 Mrads of gamma rays from a ^{60}Co source was sufficient to sterilize samples of Haemodex massively contaminated with Bacillus subtilis which is rather resistant towards the effect of ionizing radiation. This dose of ionizing radiation produced no quantitatively detectable chemical changes in dry Haemodex. The biological properties of Haemodex exposed to 2.5 Mrads remain unchanged. (auth)

Radiation Effects on Plants

11000 (ORO-3299-131) EFFECTS OF IONIZING RADIATION ON PLANT SPECIES, POPULATIONS AND ECOSYSTEMS. Progress Report, September 1, 1972–August 31, 1973. McCormick, J. F. (North Carolina Univ., Chapel Hill). [nd]. Contract AT(40-1)-3299. 7p. Dep. NTIS $3.00.

Laboratory and field studies were conducted on Pinus taeda to establish suitable criteria for evaluating radiosensitivities, to analyze radiosensitivities of various life cycle stages, and to determine the nature and extent to which environmental conditions and physiological stresses modify basic radiosensitivities. Seedlings were exposed to ozone and gamma radiation simultaneously in doses of 0,125,375, and 625 R. It was found that interactions between radiation and ozone occur. Effects of ionizing radiation on natural ecosystems were studied in a northern hardwood

forest in Wisconsin and in the El Verde rain forest in Puerto Rico. The ecology of Aster macrophyllus and Cornus canadensis in northern Wisconsin was studied with emphasis on spatial and temporal variations in population characteristics, and response to forest disturbance. (HLW)

11001 (SRO-637-2) DEVELOPMENT OF NEW TECHNIQUES OF USING IRRADIATION IN THE GENETIC IMPROVEMENT OF WARM SEASON GRASSES AND ASSESSMENT OF THE GENETIC AND CYTOGENETIC EFFECTS. Progress Report, August 1, 1972–April 30, 1973. Burton, G. W.; Hanna, W. W. (Georgia Univ., Tifton. Georgia Coastal Plain Experiment Station). 1973. Contract AT(38-1)-637. 88p. Dep. NTIS $6.50.

Effects of thermal neutrons and EMS on inbred lines, general and specific combining ability, and frequency and types of chromosome aberrations in millet (Pennisetum typhoides) were studied. The tabulated results show that EMS gave the largest percentage of non-additive genetic variance and thermal neutrons gave the lowest percentage. Studies were conducted on forage production of millet, sorghum, and corn grown from seed exposed to low doses of gamma rays and harvested at the silage stage. The tabulated results show that millet yielded nearly twice as much as sorghum and corn. Breeding studies were conducted on gamma-radioinduced mutants of bermuda grass, and heterosis resulting from crossing radioinduced mutants with their normal inbred parent was studied in corn and millet. Economic assessment studies of radioinduced mutants were carried out. Cytogenetic investigations of mutations induced in millet by gamma radiation included the following: cytoplasmic inheritance; apomixis; high ratio mutants; inheritance of mutations; linkage analysis of mutations; translocation glue linkage; production of homozygous translocation tester stocks; and temperature sensitivity of chlorophyll deficient seedling mutants. (HLW)

11002 EFFECT OF X RAYS ON THE VARIABILITY OF PEPPER PLANTS (M_1). Terzyan, R. T.; Saakyan, T. A. Biol. Zh. Arm.; 25: No. 10, 75-80(Oct 1972). (In Armenian).

The effects of different doses of x radiation (from 500 to 50,000 R) on two varieties of the pepper plant were studied. Criteria of the radiation-biological effect were the germination, energy, and dynamics of germination of the seed. Morphological changes of the plants were also studied. If the lethal dose (LD_{100}) for field germination of seed from both varieties of pepper was taken as 30,000 R, then under laboratory conditions doses of 40,000 and 50,000 R were not considered as lethal. (KSW)

11003 EXPERIMENTAL MUTAGENESIS OF APPLE-TREE. I. The Character of the Effect and the After-Effect of X-Irradiation on Development and Genotype of Malus Domestica. Kolontaev, V. M. (State Pedagogical Inst., Tambov, USSR). Genetika; 9: No. 4, 12-21(Apr 1973). (In Russian).

X irradiation affects development and genotype of Malus domestica, inducing reconstructions of chromosomes and cells with different numbers of chromosomes (from 28 to 51). The simultaneous presence in the tissue of individual and double fragments and bridges testifies to the non-delayed character of mutagenesis. Radioinduced changes are inherited through vegetative multiplication. (auth)

11004 EFFECT OF ADDITIONAL TREATMENT WITH ETHYLENIMINE OF HARICOT SEEDS AFTER GAMMA-IRRADIATION. Rukmanski, G. Ya. (Georgii Dimitrov Agricultural Academy, Sofia). Genetika; 9: No. 4, 144-146(Apr 1973). (In Russian).

The combined effect of γ irradiation (6 kR) and ethylenimine (0.006%) was studied in air-dry haricot seeds of Processor variety. Study of M_1 plants on chromosomal and organism levels showed that additional treatment of seeds with ethylenimine after irradiation decreased the lesion-inducing effect of γ irradiation. It was represented with a decrease in the number of cells with chromosome aberrations, in the number of killed M_1 plants, and with an increase in the height and the fertility of haricot. (auth)

11005 EFFECT OF THE FRACTIONATED GAMMA- AND NEUTRON IRRADIATION ON THE ROOT-TIP CELLS. Paribok, V. P.; Krupnova, G. F.; Laura, M. P. (Inst. of Cytology, Leningrad). Tsitologiya; 15: No. 4, 478-481(Apr 1973). (In Russian).

By fractionated gamma and neutron irradiation of moist seeds of Vicia faba, postirradiation kinetics of the two-hit chromosome aberrations were studied. The intervals between application of gamma and neutron irradiations were 5 min and 2 and 4 hrs. With prolongation of these intervals, the number of chromosomal aberrations remained unchanged. If the neutron irradiation preceded gamma irradiation, the number of chromosomal aberrations was increased. In the opposite situation, a decreased number of chromosomal aberrations was registered. As a possible explanation of this phenomenon, alterations in the chromosomal radiosensitivity induced by the gamma dose are suggested. In addition, it may happen that the preceding neutron dose inhibits reparation processes that could have appeared after gamma irradiation. (auth)

11006 VARIATIONS IN THE CHEMICAL COMPOSITION OF MAIZE HYBRID GRAIN INDUCED BY IRRADIATION OF THE PARENTAL COMPONENTS. Zokhrabyan, R. P. Biol. Zh. Arm.; 25: No. 8, 36-41(Aug 1972). (In Russian).

The effect of ionizing radiation on the chemical composition of the generative and vegetative organs of a maize hybrid was studied. The original hybrid form was given a dose of 1000 R of x radiation, whereupon three breeding variants were affected: either parent irradiated or both. Total Kjeldahl nitrogen, protein N, and non-protein N were assayed, as well as total sugars and fat. The results showed that total N increased when either an irradiated father, or two irradiated parents were used. The quantity of fat in the grain decreased as a result of the irradiation of a parental form. Irradiation of both parents increased the saccharide content, otherwise it resembled that of the controls. (KSW)

11007 RADIOCHEMILUMINESCENCE IN A NITROGEN ATMOSPHERE. Avakyan, G. M.; Avakyan, Ts. M. (Inst. of Physics, Erevan). Biol. Zh. Arm.; 25: No. 8, 9-13(Aug 1972). (In Russian).

The increase in the intensity of luminescence of pea plant rootlets during x irradiation in a N_2 atmosphere was studied. Four-day seedlings of the Victoria variety were irradiated while under 1.2 atmospheres of N_2 containing <0.1% O_2. Immediately after irradiation there was observed a sharp increase in the luminescence; this phenomenon could be repeated indefinitely. The luminescence curves (intensity vs time) could be modified by presoaking the rootlets in various concentrations of cysteine. (KSW)

11008 EXPERIMENTAL MUTAGENESIS IN WHEAT HYBRIDS. III. Mutating Frequency in F_2M_2 Hybrids. Avakyan, V. A. (Lab. of Induced Plant Mutations, Erevan). Biol. Zh. Arm.; 25: No. 10, 56-61(Oct 1972). (In Russian).

The mutation process in winter wheat was observed for intervarietal crossing within the species Triticum aestivum. The frequency and spectrum of new forms arising from irradiated seed of the first generation were noted. The effect of the magnitude of the dose from 10 to 15 kR was studied, with mixed results. The F_2M_2 hybrids were similarly investigated. (KSW)

11009 COMBINED ACTION OF THIOUREA AND ENDOGENOUS ANOXIA AGAINST X-RAY-INDUCED CELLULAR DAMAGE. Reddy, S. B.; Linden, W. A.; Baigent, C. (Univ., Hamburg). Strahlentherapie; 145: No. 4, 453-455(1973).

The application of thiourea and endogenous anoxia in reducing the x-ray induced chromosomal fragment frequency in the growing root tips of Allium cepa was demonstrated. Thiourea in 10^{-2} M concentration at room temperature yielded 28% of protection against ratio induced chromosome fragments. A marked increase in the radioprotective ability of this chemical agent in the same concentration was observed when the roots were treated with the agent at 35°C prior to irradiation. The probable radioprotective mechanisms, such as the depletion of oxygen by endogenous metabolism, enzyme alteration, and the role of membranes, are discussed. (GE)

11010 TIMING OF MEIOTIC EVENTS IN COPRINUS. Raju, N. B. Guelph, Ont.; Univ. of Guelph (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

Duration of meiosis from karyogamy to the completion of second division, was determined at 25°C for four species of Coprinus – C. lagopus (16 h), C. micaceus (20 h), C. comatus (31 h), and C. atramentarius (43 h). In general the difference in the total duration of meiosis in the four species is the result of a proportional increase or decrease in all the meiotic stages. The meiotic stages from karyogamy to diplotene account for 80 to 90% of the total duration of meiosis and other stages from diakinesis to the tetrad formation are extremely short. Non-lethal doses of gamma irradiation (5 krad) increased meiotic recombination in C. lagopus when the treatments were given at the beginning of karyogamy. The stage of meiosis was judged to be late leptotene and the duration of the sensitive period was assessed to be 3 to 4 h. In this fungus, the radiation sensitive stage is distinct from the cold sensitive stage (pachytene). The additive effect of irradiation at early karyogamy followed by cold treatment in pachytene suggested that the two factors influenced different steps in the recombination process. On the other hand, irradiation followed by heat treatment did not significantly alter recombination frequency as compared to single treatments. It was surmised that radiation and high temperature act on the same factor(s) or at the same step(s) to bring about a similar net result. Irradiation at leptotene

may be causing single strand breaks in DNA that eventually participate in exchange. (ERB)

11011 APPLICATION OF IONIZING RADIATION TO CROSS BREEDING IN PLANT. Report of Symposium held at Ohmiya, Japan, July 14–15, 1971. Gamma Field Symposia, Number 10. Ohmiya, Japan; Institute of Radiation Breeding (1971). 79p. (In Japanese and English). (CONF-710740-).

Separate abstracts were prepared for the four symposium papers included in this publication. (ERB)

For abstracts of individual papers see: 11012–11015.

11012 EFFECTS OF GAMMA IRRADIATION ON SELF-INCOMPATIBILITY OF CABBAGE (BRASSICA OLERACEA L.). Hosoda, T.; Namai, H.; Tsuyama, T. (Tokyo Kyoiku Univ.). Gamma Field Symp.; No. 10, 1-10(1971).

The effects of γ irradiation on self-incompatibility at various reproductive stages of the self-incompatible cabbage were studied. The results indicate that self-fertility of self-incompatible cabbage becomes even higher when the plant is irradiated after pollination, especially between six days and two weeks after pollination. (ERB)

11013 EFFECT OF CHRONIC GAMMA RADIATION ON HYBRIDIZATION BETWEEN LYCOPERSICON ESCULENTUM AND L. PERUVIANUM. Yamakawa, K. (National Inst. of Agricultural Sciences, Ohmiya, Japan). Gamma Field Symp.; No. 10, 11-31(1971).

From symposium on application of ionizing radiation to cross breeding in plant; Obmiya-machi, Ibaraki-ken, Japan (14 Jul 1971). See CONF-710740-.

Radiation effects on the interspecific hybridization between Lycopersicon esculentum and L. peruvianum, which is resistant to many tomato diseases, were investigated through the years 1966, 1967, 1969, and 1970. Throughout the experiments, radiation had both deleterious and beneficial effects. Irradiation after meiosis including mature pollen irradiation had only deleterious effects. Long-term chronic irradiation including at least meiosis and in most cases all microsporogenesis from pollen-mother-cell differentiation to dehiscence had a beneficial effect when the exposure rate was suitable, but the effect was deleterious when the rate was too high. The way in which radiation acts beneficially was presumed to be genetic rather than physiological from the finding that a larger number of well-developed seeds were obtained from a single fruit when the irradiation was extended. The possibility that mutation was responsible for the effect was discussed. (auth)

11014 EFFECT OF GAMMA IRRADIATION ON RECOMBINATION IN RICE, ORYZA SATIA L. Omura, T.; Yamaguchi, I. (Khushu Univ., Fukuoka). Gamma Field Symp.; No. 10, 33-40 (1971).

From symposium on application of ionizing radiation to cross breeding in plant; Obmiya-machi, Ibaraki-ken, Japan (14 Jul 1971). See CONF-710740-.

The effect of gamma irradiation on the recombination in rice was investigated. The recombination values strikingly increased in the regions of Pl–lg, C–ws, and g–Rc by the irradiation during the reproductive stage, but not in the other region. Therefore, in rice, as well as in Drosophila and Chlamydomonas, the effect of irradiation on the recombination differs with different region. The sensitive stage during which the recombination is affected by irradiation was not found in rice, though it was found in Drosophila and Chlamydomonas. Results on the relationship between dosage and the effect of irradiation show that the changing recombination probably results from true crossover. (auth)

11015 RADIATION INDUCED INTERSPECIFIC GENE TRANSFERS IN GENUS NICOTIANA. Niwa, M.; Murase, T. (Tokyo Univ.). Gamma Field Symp.; No. 10, 41-58(1971).

From symposium on application of ionizing radiation to cross breeding in plant; Obmiya-machi, Ibaraki-ken, Japan (14 Jul 1971). See CONF-710740-.

The effect of γ or x radiation on the frequency of interspecific gene transfer in a species hybrid of Nicotiana was studied. Three separate studies were made as follows: induction of gene transfer by irradiation at the gametogenetic stage; differential rate of radioinduced gene transfer during gametogenesis; and induction of interspecific gene transfer by irradiation of seeds and enhancement of the frequency by postirradiation centrifugation. Results indicated that gene transfer can be induced by irradiation in the gametogenic stage and by irradiation of soaked seeds. Centrifugation was shown to enhance interspecific gene translocation. (ERB)

11016 COMPARATIVE STUDY OF THE ACTION OF X RAYS AND GIBBERELLIC ACID ON SEEDS OF CREPIS CAPILLARIS. Batikyan, G. G.; Danielyan, A. Kh. (Erevan State Univ.). Biol. Zh. Arm.; 25: No. 12, 30-32(Dec 1972). (In Russian).

Air-dried seeds of Crepis capillaris were given 4000 R of x radiation, or treated with gibberellic acid in two concentrations: 0.02 and 0.05% for periods from 2.4 to 6 hr. The data indicated that gibberellic acid, like x radiation, exhibited mutagenic action on seeds of C. capillaris, causing chromosomal aberrations in meristematic cells. A 0.02% solution of gibberellic acid caused 11.1% more aberrations than in the controls, and 18.9% fewer than in irradiated seeds. (KSW)

11017 EFFECT OF IRRADIATION WITH GAMMA-RAYS ON EMBRYO SAC IN M_1 GENERATION OF RICE. Vijendra Das, L. D.; Sree Rangasamy, S. R. (Agricultural Coll., Coimbatore, India). Curr. Sci. (India); 42: No. 12, 437-438(20 Jun 1973).

The causes of spikelet sterility in irradiated rice in the M_1 generation were studied. The ovules of seedlings obtained from γ-irradiated dry seeds were prepared for studies of the embryo sac. It was concluded that degeneration of egg nucleus or non-function of eggs, aberration in embryo sac structures, abortion of embryos, and instability of endosperm divisions lead to spikelet sterility. (ERB)

11018 BIOLUMINESCENCE OF SEEDS OF RYE-GRASS AND BARLEY. Kivinitty, K.; Pitkaenen, U. (Univ. of Oulu, Finland). Acta Biol. Acad. Sci. Hung.; 23: No. 3, 247-252(1972).

Thermoluminescence was measured on seeds of rye-grass and barley. The seeds were irradiated at the temperature of liquid nitrogen, and the measurement was made by a fluorescence spectrophotometer. The uv-induced fluorescence of the seeds was also studied. A fluorescence emission of the same wavelength was obtained by means of a uv-inducement light, used at two different wavelengths. Fluorescence emission was strongly dependent on temperature. Thermoluminescence emission exhibited two peaks, and the intensity of thermoluminescence increased as a function of the irradiation dose. No differences were found between the spectra of various seeds. (auth)

11019 EVALUATION OF EDDY DIFFUSION COEFFICIENTS BY THE MEASUREMENT OF SPALLATION PRODUCTS. Hartwig, S.; Sittkus, A. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Z. Naturforsch.; 27a: No. 10, 1413-1417(1972). (In German).

By measuring the isotopes ^{32}P, ^{33}P, and ^{7}Be in rain samples for several years in Freiburg, it was possible to determine two tropospheric eddy diffusion coefficients. The results of the calculations for the summer period are: K(V) (vertical coefficient) = 3×10^5 cm^2/sec, K(H) (horizontal coefficient) = 4×10^9 cm^2/sec, and for the winter period: K(V) = 1.5×10^5 cm^2/sec, K(H) = 2×10^{10} cm^2/sec. K(H) is valid as well for the stratosphere. (GE)

11020 RADIATION STABILITY OF TOMATO HYBRIDS. Agadzhanyan, A. M. (Inst. of Agriculture, Erevan). Biol. Zh. Arm.; 25: No. 9, 86-91(Sep 1972). (In Russian).

The influence of x radiation on tomato hybrids and their parental forms was studied. Doses of 25 kR were administered to hybrids of Lycopersicon esculentum and L. pinpinellifolium with resulting depression of growth and development. (KSW)

11021 COMPARATIVE STUDY OF THE RADIOSENSITIVITIES OF TWO CULTIVARS OF SOFT WHEAT (TRITICUM AESTIVUM). Fossati, A. Diss. No. 4716. Zurich; Eidgenoessische Technische Hochschule (1971). 25p. (In French).

Thesis.

The difference of radiosensitivity between two cultivars of soft wheat, Zenith and Probus, was studied. Zenith is more resistant to gamma rays than Probus. The difference is independent of the harvest year of the seeds and the sensitivity criteria studied: height of the first leaf and length of the roots after eight days of germination, survival after four weeks, sterility of pollen and mortality during maturation. The experimental results make it possible to exclude several factors which could have explained the difference in radiosensitivity: size and water content of the kernels, temperature of germination, different types of radicals, and different amounts of naturally occurring radioprotective substances with SH groups. Because none of the above mentioned factors can explain the difference in radiosensitivity a difference in an enzymatic repair process is postulated. The difference between the two cultivars is very small after treatment with neutrons. (HLW)

11022 FERTILIZATION OF THE COTTON PLANT G. HIRSUTUM IN THE SECOND GENERATION OF PLANTS RELATIVE TO IRRADIATION OF THE SEED BY GAMMA RAYS. Kalyagina, L. G. (Inst. of Experimental Plant Biology, Tashkent). Uzb. Biol. Zh.; No. 1, 39-41(1973). (In Russian).

Cotton seeds (variety 108-F) were irradiated with doses of 3,

10, and 20 kR (20 R/sec) and the flower buds and gynoecia from the second generation were collected for examination. In the ovules of a number of the second generation plants the fertilization process was disrupted; however, the number of anomalies observed was significantly less than that number noted in the first generation. (KSW)

11023 SENSITIZING EFFECT OF 5-BROMODEOXYURIDINE (BUdR) ON GAMMA-IRRADIATED CREPIS CAPILLARIS CELLS AT PRESYNTHETIC PERIOD OF THE CELL CYCLE. Safonova, G. M.; Tarasov, V. A. (Inst. of General Genetics, Moscow). Genetika; 9: No. 3, 41-45(Mar 1973). (In Russian).

The work was carried out on meristem cells of Crepis capillaris seedlings. A sensitizing effect of BUdR was studied upon its incorporation into chromosomal DNA at S- or G_1-phases of the first cycle after the beginning of germination. Cytogenetic effects of BUdR on metaphase cells exposed to gamma-irradiation at the G_1-phase of the second cycle were examined. Incorporation of BUdR into chromosomal DNA at the G_1-phase, of the first cycle resulted in the increase of the mutability similar to that caused by the incorporation of BUdR at the S-phase of the first cycle in cells exposed to gamma irradiation at presynthetic phase of the second cycle. It is suggested that a sensitizing effect of BUdR, as regard to cytogenetic alterations, is not influenced by its total content in chromosomal DNA, but is determined by its availability in the sites of a chromosome in which unscheduled synthesis of DNA occurs independently on the treatment with mutagens. (auth)

Radiation Effects on Animals

Man

Refer also to abstracts 10870, 10878, 10992, 12015, and 12017.

11024 (BNWL-1183-14) MEASUREMENT OF RADIATION EXPOSURE OF ASTRONAUTS BY RADIOCHEMICAL TECHNIQUES. Quarterly Research Report to the NASA Manned Spacecraft Center, January 1, 1973-April 1, 1973. Brodzinski, R. L. (Battelle Pacific Northwest Labs., Richland, Wash.). 15 Apr 1973. Contract AT(11-1)-1830. 12p. Dep. NTIS $3.00.

A cosmic radiation dose to the Apollo 17 crew of ≤210 mR was calculated from the concentrations of ^{24}Na in their postflight urine specimens. The complete absence of measurable quantities of ^{22}Na indicates the radiation doses were among the lowest ever received on a mission of this duration. The levels of ^{42}K administered by post-flight injection are also reported for these samples. Antimony-124 and iridium-192 were observed for the first time in urine specimens. The excretion of these radioisotopes and of ^{60}Co correlated well with that of ^{51}Cr; they are shown to be impurities in the radiochromium tracer present at levels as high as 4.4% at the time of injection. The ^{40}K, ^{59}Fe, and ^{137}Cs concentrations are also reported and appear to be normal. (auth)

11025 (NRPB-R-10) STUDY OF CHROMOSOME ABERRATION YIELD IN HUMAN LYMPHOCYTES AS AN INDICATOR OF RADIATION DOSE. III. A Review of Cases Investigated: 1971-1972. Purrott, R. J.; Lloyd, D. C.; Dolphin, G. W.; Eltham, E. J.; Platt, S. K.; Tipper, P. A.; Strange, C. M. (National Radiological Protection Board, Harwell (England)). Feb 1973. 27p. UK 50 pence.

Results from cytogenetic investigations into 54 cases of suspected overexposure to radiation are reviewed. This report is a sequel to NRPB-R5 which contained data from the first 41 studies; results from all 95 investigations were pooled for general analysis. Brief accounts are given of the circumstances behind the 54 later investigations and where possible physical estimates of dose have been included for comparison. From data on lymphocyte half-life obtained in the first series of cases, an attempt was made to allow for the loss of damaged cells where the exposure occurred some years previously. The presence of incomplete chromosome damage appears to be characteristic of exposures which occurred some years ago. The ratio of dicentrics to acentrics observed in the accident investigation was compared with that obtained in recent research studies. The comparison supports the impression that the majority of confirmed over-exposures were very small in terms of whole body dose, the exceptions being where high acute doses were undoubtedly received. The problem of interpreting aberration yield in cases of exposure to low kV non-penetrating radiation and to partial body doses, such as to fingers, has been discussed. In addition, the problem of selective irradiation of lymphocytes by internally incorporated radionuclides in, for example, lymph nodes and highly vascular tissue, has been examined. Difficulties have been encountered in culturing leukaemic lymphocytes. These and other areas of research that would benefit cytogenetic dosimetry are discussed. (auth)

11026 COLLIMATION IN REDUCING MALE GONADAL DOSES IN PUERTO RICO: 1968. Gileadi, M.; Gileadi, A. E. (Puerto Rico Nuclear Center, Mayaquez). Health Phys.; 25: No. 1, 43-49(Jul 1973).

Gonadal irradiation doses from diagnostic abdominal x-ray procedures, measured as part of the Joint Radiation Survey, Puerto Rico, 1968, were used to determine the per cent by which the testes doses were reduced, when x-ray unit was equipped with a variable collimator as opposed to when it was not. Significant dose reduction was accomplished by the use of a variable collimator in the case of a number of diagnostic x-ray procedures. Using dose reduction ratios determined in the present study, along with demographical data published by the Government of Puerto Rico and statistical data obtained in the Joint Radiation Survey resulted in a reduction in the genetically significant dose for males by 38% and the mean male gonadal dose by 43%. (auth)

11027 LIVING WITH RADIATION. London; Her Majesty's Stationery Office (1973). 13p. 10 Pence.

The booklet explains the nature of ionizing radiation and radioactivity, describes some of the benefits and risks arising from their use, and outlines the principal steps taken to protect the public and workers from these risks. Some of the sources of artificial radiation, the biological and genetic effects of radiation, the need for responsible judgement regarding uses of radiation in medicine, industry, and nuclear power plants, and the exposure of the public from radioactive waste disposal are briefly discussed. Safeguards for the profitable use of ionizing radiations are described. (ERB)

11028 RADIODIAGNOSTICS OF SHOULDER JOINTS OF WOMEN IRRADIATED FOR CANCER OF THE BREAST. Kolar, J.; Bek, V.; Drugova, B.; Drapelova, D. (Charles Univ., Prague). Cesk. Radiol.; 26: No. 6, 320-324(Nov 1972). (In Czech).

The important complex of bone changes in shoulder joints in women irradiated for cancer of the breast is discussed. Clinical complaints sometimes lead to suspicion of metastasis. For differential-diagnostic purposes, the most advantageous investigations are combined radiographic and isotopic skeletal tests. Atrophic and reparative processes in the irradiated bones can be differentiated from destructive changes caused by metastasis in the majority of cases. (auth)

11029 NUCLEAR SAFETY PROJECT. Fischer, M. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 5: No. 1, 1-7(1973). (In German).

The main topics and the objects of the Project of the Gesellschaft fuer Kernforschung (Society for Nuclear Research) and its integration into the overall radiation protection and safety program of the Federal Republic of Germany are briefly outlined. (GE)

11030 BIOLOGICAL BASIS FOR HIGH-LET RADIOTHERAPY. Withers, H. R. (Univ. of Texas, Houston). Radiology; 108: No. 1, 131-137(Jul 1973).

Tissues may respond differently to high- and low-LET radiations for two known reasons: the oxygen enhancement ratio (OER) is less for high-LET radiation, and the relative biological effectiveness (RBE) varies with cell mitotic stage. If a large fraction of the tumor-cell population is hypoxic, or if a small fraction does not reoxygenate and remains hypoxic throughout a course of fractionated radiotherapy, then high-LET beams would be more effective than low. The comparative distribution of cells in relatively radioresistant phases of the division cycle in tumor and critical normal tissues may determine whether high-LET radiation will offer a therapeutic advantage or disadvantage. (auth)

11031 RADIOBIOLOGY OF HEAVY PARTICLE RADIATION THERAPY: CELLULAR STUDIES. Hall, E. J. (Columbia Univ., New York). Contract AT(11-1)-3243. Radiology; 108: No. 1, 119-129(Jul 1973).

The therapeutic merits of various heavy particles are compared with conventional photon radiations. Lowering of the OER (oxygen-enhancement ratio) and improvement in the depth-dose pattern are the principal advantages sought. Neutrons result in a somewhat lower OER but barely equal depth-dose patterns of x- and gamma-ray units. Protons produce excellent dose distributions but no reduction in OER. Helium ions compare with protons in depth-dose distribution. Negative pi mesons improve both depth-dose pattern and OER but neutrons have a lower OER and protons produce better dose profiles. High energy heavy nuclei show great promise of lowered OER, but more radiobiological data are needed. (auth)

11032 HUMAN RADIATION HEPATITIS. A Morphologic Study with Emphasis on the Late Changes. Lewin, K.; Millis, R. R. (Stanford Univ., CA). Arch. Pathol.; 96: No. 1, 21-26 (Jul 1973).

The pathologic findings of 19 autopsied cases of radiation hepatitis fall predominantly into three groups: acute, chronic, and intermediate, although there is some overlap between them. The changes of acute radiation hepatitis are similar to those previously described, although an additional feature was noted, namely, intrasinusoidal and extrasinusoidal reticulin proliferation. The changes of chronic radiation hepatitis that were not previously emphasized are described and are characterized by a shrunken atrophied liver showing lobular collapse and distortion, portal tract fibrosis, and persistence of vascular damage. Intermediate cases show changes of both the acute and chronic groups. The relationship of radiation hepatitis to dosage of radiation and survival following radiation is discussed. (auth)

11033 PRETHERAPEUTIC INVESTIGATIONS WITH ACCELERATED HEAVY IONS. Tobias, C. A. (Univ. of California, Berkeley). Contract W-7405-eng-48. Radiology; 108: No. 1, 145-158(Jul 1973).

To predict the RBE of heavy ions, not only dose distribution but also distribution of atomic numbers, flux and energy of the various particles comprising the beam must be known. Heavy ion beams of wide energy spread will allow irradiation of relatively large tumors several centimeters in diameter with good dose distribution and high LET. Advantages are greater with deep tumors of relatively small volume. Using a particle of given atomic number, the smaller the tumor, the higher the mean LET. The author, experimenting with the Bevatron at Berkeley, believes that biological effects become more or less independent of oxygen concentration if caused by high density ionization in the core region of the particle tracks. (auth)

11034 CHROMOSOME ABERRATION ANALYSIS AS A DOSIMETRIC TECHNIQUE IN RADIOLOGICAL PROTECTION. Dolphin, G. W.; Lloyd, D. C.; Purrott, R. J. (National Radiological Protection Board, Harwell, Eng.). Health Phys.; 25: No. 1, 7-15(Jul 1973).

Work of the Cytogenetics Laboratory of the National Radiological Protection Board during the last 4 yr (1968 to 1972) is reviewed. A brief account of the culture and scoring techniques is given. Calibration curves were obtained for fission neutrons, x rays, and ^{60}Co gamma rays. These were used to estimate equivalent whole-body dose from blood samples taken from 67 cases of known or suspected over-exposure investigated in the laboratory. Studies were carried out on groups of radiation workers and radiotherapy patients. Data from some patients treated with colloidal ^{198}Au provide an example of how the study of the distribution of dicentrics among cells can give useful information about partial-body irradiation. (auth)

11035 ADOLESCENT GROWTH PATTERNS IN SURVIVORS EXPOSED PRENATALLY TO THE A-BOMBS IN HIROSHIMA AND NAGASAKI. Shohoji, T.; Pasternack, B. (New York Univ.). Health Phys.; 25: No. 1, 17-27(Jul 1973).

Since 1950 approximately 1600 exposed and control subjects who were in utero at the time of the atomic bombings (ATB) in Hiroshima and Nagasaki have been studied by the Atomic Bomb Casualty Commission (ABCC). The sample was drawn from the population of in utero children ATB who were either exposed or nonexposed (entering Hiroshima and Nagasaki between October 1945 and October 1955). Matching of subjects was carried out so that all available children exposed under 2000 m were entered into the study. For each child exposed proximally an attempt was made to include a child exposed distally and one not-in-city ATB-matched by sex, month of birth, and economic status. Children at all stages of gestation were included. In this report, a four-parameter Gompertz curve is used to characterize the standing height growth during adolescence of these children. Based on maximum likelihood estimates of the four parameters, statistical analyses are performed to test for differences between sexes, cities, trimesters ATB, and exposure groups. The main findings are: within each city males significantly differ from females; males and females in Nagasaki significantly differ from those in Hiroshima, respectively; differences among trimester ATB groups are, almost without exception, nonsignificant; and differences among exposure groups are greater for males than for females, but no consistent findings relate growth impairment to exposure group and/or trimester ATB. (auth)

11036 EXCRETION OF THE LUTEINIZING HORMONE UNDER EXPOSURE OF THE ORGANISM TO SMALL DOSES OF IONIZING RADIATION. Gelashvili, K. D.; Piradashvili, D. Z. (Inst. of Roentgenology and Medical Radiology, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 70: No. 2, 489-491(May 1973). (In Russian).

Prolonged exposure of women of reproductive age to small doses of ionizing radiation results in a tendency of the excretion of LH to rise to the upper limits of the norm. The heightened excretion of LH is more pronounced during menopause. Some increase of the average indices of LH during menopause in contrast to the reproductive period in both control and exposed women should be noted. (auth)

11037 RADIATION PROTECTION LEGISLATION IN THE EUROPEAN COMMUNITY COUNTRIES. Recht, P.; Eriskat, H. (Commission of the European Communities, Brussels). Rayonnements Ionis. Tech. Mes. Prot.; No. 1, 3-7(Jan 1973). (In French).

Safety standards introduced by the European Community form an essential part of the health physics policy established. These standards were approved by Euratom in the form of Directives fixing the basic safety standards for the protection of working personnel and the population from dangers due to ionizing radiations. These standards establish the maximum permissible radiation doses for working personnel and the population, and organize the medical surveillance of working personnel as well as the monitoring of the ambient radioactivity. The principles of these standards are based on the scientific recommendations of the ICRP. The various member countries were given the choice of how they would implement regulations in accordance with these basic standards in the frameworks of their particular administrative systems. The regulations adopted in each of the member countries are analyzed. (FR)

11038 PROTECTION OF WORKING PERSONNEL IN THE CEA. Gauvenet, A. (Commissariat a l'Energie Atomique, Paris); Pomarola, J. Rayonnements Ionis. Tech. Mes. Prot.; No. 1, 9-16(Jan 1973). (In French).

The different types of radiation or classical risk encountered are classified. The regulations concerning radiation protection are then described. The subject is divided into: prevention, monitoring and measuring radiations, and interventions. The facilities available in the various C.E.A. centers are given (specialized personnel, locations) and data are presented concerning the annual radiation doses received by the personnel (which are considerably less than the maximum permissible doses). (FR)

11039 PROMENEVI URAZHENNYA I MEKHANIZMI PROTIPROMENEVOGO ZAKHISTU. (Radiation Injury and Anti-Radiation Defenses). Barabol, V. A. Kiev; Zdorov'ya (1971). 144p.

The widespread use of nuclear radiations and radioactive isotopes in many different areas of the national economy, medicine in particular, has introduced problems of their action on the organism and of protection against them. This book is concerned with the mechanisms of such radiations and the development and growth of exchange and structural damage, and paths for effective interference and counter-action. The author's own work in developing anti-radiation measures is described, such as the employment of gallic acid and other phenolic compounds and the mechanisms of their radioprotective action. (tr-auth)

11040 INFLUENCE OF DOSE FRACTIONATION SCHEDULE OF IRRADIATION ON TUMOROUS AND NORMAL TISSUE. Lessel, A.; Eichhorn, H. J.; Rotte, K. H. (Institut fuer Krebsforschung, Berlin). Radiobiol.-Radiother.; 14: No. 2, 129-135(1973). (In German).

It was investigated by means of clinical experimental series with human tumors (bronchial and esophageal carcinoma) and normal tissues (spinal-marrow and lung) how far radiobiological experimental results can be taken over into clinical radiation therapy. The influence of different rhythms of fractionation on the tumor was investigated by means of autopsy preparations. The annihilation of the tumor and for normal tissue the demonstration of a complete transsection of the spinal cord and the radiological demonstration of a fibrosis, respectively, were taken as criteria. The results were compared with the same total dose after daily low single doses (250 R tumor dose), 5-day high single doses (500 R tumor dose), one and three high initial doses (500 R tumor dose and 1000, 800, 800 R tumor dose) followed by daily low single doses and the so-called split series with daily low single doses and an irradiation pause of 3 weeks. The patients were checked by means of the χ^2-test with respect to their homogeneity. The statistical evaluation of the material was done by means of Koller's tables. A statistically significant difference was only shown between the series with high single doses and a higher initial dose in favor of low single doses. Possible differences of the effect are about 30% in favor of low and not of high single doses as could be expected according to radiobiological experimental results and recent literature. Further clinical experiments by means of alternating series are necessary. (auth)

11041 INTEGRATING, SIMULTANEOUS RADIATION MEASUREMENT WITH LiF THERMOLUMINESCENCE DOSIMETERS

IN RECTUM, BLADDER, AND URETERS IN THE TREATMENT OF CARCINOMAS OF THE UTERINE CERVIX WITH $^{60}Co\gamma$ APPLICATORS. Weise, W.; Reichel, G.; Schultze, H.; Morczek, A.; Bernoth, E. (Medizinische Akademie, Magdeburg, Ger.). Radiobiol.-Radiother.; 14: No. 2, 153-165(1973). (In German).

In the contact therapy of carcinomas of the uterine cervix the necessity of a direct dosimetry of the exposed neighboring organs of the uterus is pointed to. These are rectum, bladder, and ureters. The possibility of simultaneous integrating direct radiation measurements in rectum, bladder, and ureters are shown and compared by means of radiation measurements with three cobalt-60 applicators in patients with carcinomas of the uterine cervix discussed in detail. The radiation measurements were made by means of LiF thermoluminescence dosimetry. For the radiation measurement in bladder and ureters the production of special dosimeter systems is reported that are able to detect the radiation exposure to both organs simultaneously. Additionally, radiation measurements are performed in bladder and rectum by a ionization probe. Based on our examinations we conclude that already at the present state of development LiF thermoluminescence dosimetry meets the requirements being put to such a dosimeter. (auth)

11042 RADIATION ACCIDENTS. Sutra-Fourcade, Y. (Centre de Marcoule, Bagnols-sur-Ceze, France). Rayonnements Ionis. Tech. Mes. Prot.; No. 1, 27-35(Jan 1973). (In French).

A series of characteristic accidents that can occur with nuclear installations, irradiation installations, and particle accelerators, and during industrial radiography and the transport of radioactive materials are enumerated together with the risks from thefts or losses of medical and nonmedical radioactive sources. The direct consequences for the personnel (integrated doses superior to the permissible norms) or to the environment (presence of radioactivity) are considered. Analysis of the causes of accidents revealed that 75% of them are due to human error and 25% due to materials failure. The means for effective personnel protection are enumerated. (FR)

11043 TRAINING IN HEALTH PHYSICS. Bocquet, H. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Rayonnements Ionis. Tech. Mes. Prot.; No. 1, 37-41(Jan 1973). (In French).

In order to protect individuals from the radiological consequences of radiations, it is necessary that certain regulations concerning prevention, and protection against irradiation and contaminations are respected. Health physics courses were given at the Institut National des Sciences et Techniques Nucleaires to 250 qualified senior technicians, 400 less qualified technicians, and other personnel from the C.E.A. and private and public enterprise. The qualifications required for a person to be deemed competent are examined. (FR)

Vertebrates

Refer also to abstracts 10993 and 11081.

11044 (BNWL-1750(Pt.2), pp 7.17-7.18) RADIATION EFFECTS IN WILD-CAUGHT ADULT AND JUVENILE DEER MICE, PEROMYSCUS MANICULATUS. Fitzner, R. E.; Gies, R. A.; Hedlund, J. D.; O'Farrell, T. P. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

Data obtained from probit transformation of survivorship curves indicated that the $LD_{50/30}$ ± SD values for γ irradiation were 890 ± 12 rad for adult deer mice (Peromyscus) and 904 ± 13 rad for juvenile offspring of the former. There were no significant differences between the estimates of median lethal mortality, either between age groups or between 1966 (919 rad) and 1972 exposures. The deer mouse is still the most radiation-resistant of the wild species tested thus far in the Hanford region. (CH)

11045 (BNWL-1750(Pt.2), pp 7.18-7.19) RADIATION EFFECTS IN FREE-RANGING SMALL MAMMALS. O'Farrell, T. P.; Hedlund, J. D.; Gies, R. A.; Fitzner, R. E.; Gilbert, R. O.; Olson, R. J. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

Results are reported from a study of the effects of exposure to sublethal doses of ionization radiation on the life span and reproductive performance of pocket mice (Perognathus parvus) and deer mice (Peromyscus maniculatus) confined in the laboratory and free-ranging. Preliminary data indicated that radioinduced and natural mortality may be synergistic in unconfined populations. (CH)

11046 (COO-1210-81) ACQUIRED IMMUNOLOGIC TOLERANCE IN CHIMERAS AND HISTOCOMPATIBILITY FACTORS IN CATTLE AND THEIR RELATIONSHIP TO THOSE IN HUMANS. Annual Technical Progress Report XI, September 15, 1972-May 15, 1973. Stone, W. H. (Wisconsin Univ., Madison. Lab. of Genetics). 28 May 1973. Contract AT(11-1)-1210. 15p. Dep. NTIS $3.00.

Preliminary results of studies on the effects of whole-body γ irradiation at various doses and dose fractionation schedules on the hematopoietic system and other physiological parameters of 35 pairs of chimeric cattle twins are reported. Immune reactions in cattle were studied following the injection of homogenates of various human tissues in an effort to obtain antisera for testing human lymphocyte antigen for evaluation of the prognosis of tissue transplant growth. Preliminary findings are reported. (CH)

11047 (COO-3380-5) EFFECT OF DOSE FRACTIONATION ON THE RECOVERY OF RADIATION-INDUCED ONCOGENESIS IN RAT SKIN. Albert, R. E.; Burns, F. J. (New York Univ., N.Y. Inst. of Environmental Medicine). 1973. Contract AT(11-1)-3380. 20p. (CONF-730436-1). Dep. NTIS $3.00.

From American Association for Cancer Research meeting; Atlantic City, New Jersey, USA (11 Apr 1973).

Rats were initially irradiated with 1000 R in the resting phase of the hair growth cycle. Second irradiations were made 24 hr later with doses of 100, 2000, 3000, and 4000 rads. The rats were observed weekly for the first 4 weeks and at 6-week intervals thereafter. Graphs are presented to show follicle survival curves as a function of total dose for single and fractionated exposures. Graphs are also presented to show cumulative tumors per rat as a function of the postirradiation elapsed time for single and fractionated exposures. Results indicated that recovery for tumor induction is as complete for 24 hr between fractions as for 31 days between fractions; this fact led to the conclusion that recovery is primarily an intracellular process and does not involve a significant amount of cell proliferation. Recovery for carcinogenic damage was complete and as rapid as recovery observed in vitro for cell lethality. (HLW)

11048 (COO-3380-6) SIEVE EFFECT FOR TUMOR INDUCTION WITH LOW VOLTAGE X-RAYS IN RAT SKIN. Albert, R. E., Burns, F. J. (New York Univ., N. Y. Inst. of Environmental Medicine). 1972. Contract AT(11-1)-3380. 14p. (CONF-730431-3). Dep. NTIS $3.00.

From annual meeting of the Radiation Research Society; St. Louis, Missouri, USA (29 Apr 1973).

Rats were anesthetized and exposed to x rays from Grenz ray tubes operated at 25 KVP through a beryllium window. Sieves were constructed of 0.35 mm brass with holes punched in a regular pattern. The rats were observed every six weeks and all lesions were recorded. Results indicated that significant sieve pattern protection occurred for tumor induction by Grenz rays and the protection was unaffected by irradiating the tissue surrounding the pore with $\frac{1}{3}$ the pore dose. It is suggested that sieve protection is a property of low LET radiation and is independent of the scattering properties of the radiation. (HLW)

11049 (COO-3380-7) GROWTH AND INDUCTION KINETICS OF RADIATION-INDUCED RAT SKIN TUMORS. Burns, F. J.; Vanderlaan, M.; Albert, R. E. (New York Univ., N. Y. Inst. of Environmental Medicine). 1970. Contract AT(11-1)-3380. 16p. (CONF-730431-4). Dep. NTIS $3.00.

From annual meeting of the Radiation Research Society; St. Louis, Missouri, USA (29 Apr 1973).

Tumors were induced in rat skin with single electron doses from 1500 to 6000 rads. Tumor diameters were measured from photographs every four weeks and a computerized least square procedure was devised which allowed Gompertz functions to be fitted to the experimental growth data. The growth curves of 153 tumors were analyzed and a model was constructed to describe tumor growth data. Graphs are presented to show relationships between dose and growth rate of tumors. (HLW)

11050 (ORO-2903-48) STUDIES IN THE USE OF IONIZING RADIATIONS AS STIMULI. Progress Report, June 16, 1972-June 1, 1973. Smith, J. C. (Florida State Univ., Tallahassee. Dept. of Psychology). [nd]. Contract AT(40-1)-2903. 8p. Dep. NTIS $3.00.

Rats were assigned to sixteen treatment groups of eight rats each. Half of the rats were exposed to 100 R of gamma radiation from a ^{60}Co source and the other half were sham irradiated. After various delay periods, the rats were given access to drinking tubes containing saccharin solution and cumulative intakes were recorded for all groups. When the saccharin was first presented $1\frac{1}{2}$ hrs after irradiation, taste aversion began immediately. When the delay was either shorter or longer than $1\frac{1}{2}$ hrs, the time for aversion to develop was longer. Prior experience with the taste solution had an effect on subsequent conditioning dependent on the concentration of the solution, the

duration of the experience, and the amount of ^{60}Co exposure. (HLW)

11051 (PU-2000-99) LOW-LEVEL X IRRADIATION OF THE BRAIN DURING DEVELOPMENT: MORPHOLOGICAL, PHYSIOLOGICAL, AND BEHAVIORAL CONSEQUENCES. Annual Progress Report, September 1, 1972-August 31, 1973. Altman, J. (Purdue Univ., Lafayette, Ind. Dept. of Biological Sciences). 1973. Contract AT(11-1)-2000. 12p. Dep. NTIS $3.00.

A detailed ultrastructural examination was made of the effects of four different schedules of x-irradiation of the rat cerebellum, which led to total degranulation; subtotal degranulation; granule cell ectopia; and parallel fiber reorientation. Considerable progress was made in the analysis of the lasting motor effects of moderate and severe retardation of the cerebellar cortex produced by two schedules of low-level, focal irradiation of the cerebellum. Irradiation of the head region containing the hippocampus with different schedules of low-level x-irradiation led to the reduction of granule cells of the dentate gyrus by an average of 84%, the presumed complement of postnatally acquired neurons of the hippocampus. It was established that granule cell agenesis produced by low-level x-irradiation of the hippocampus produced behavioral deficits in the adult which are comparable to surgical destruction of the hippocampus as a whole. (auth)

11052 (TID-26345) STUDY OF THE STATISTICAL DISTRIBUTION OF COLONY COUNTS IN THE SPLEEN COLONY ASSAY FOR HEMOPOIETIC COLONY-FORMING CELLS. Mossman, K. L. (Tennessee Univ., Knoxville). Aug 1973. 82p. Dep. NTIS $6.25.

Thesis.

The distribution of colony counts was determined in various strains of mice and varying treatments of donor and recipient animals. The distribution of spleen colony counts in C3H mice given radiation and cells the same day was consistent with the binomial distribution. In addition, analysis of data from two other laboratories indicated that colony counts in two other strains of mice were also compatible with the binomial. The distribution of colony counts in C3H mice given bone marrow cells three days after irradiation was inconsistent with the binomial. The distribution of colony counts in C3H mice given bone marrow from irradiated donors was inconsistent with the binomial. The distribution of colony counts in C57BL/6 mice given radiation and cells the same day was inconsistent with the binomial. A consistent explanation of the data can be constructed on the assumption that the principal determining factor in the spleen colony assay is the number, N, of niches in the spleen competent to support the growth of a gross nodule. These niches are seeded with a probability, p, that depends on the number of bone marrow cells injected. N and p are the parameters of a binomial distribution. The statistics of the assay procedure can be fully accounted for by this niche hypothesis. The niche, in the context of the hemopoietic inductive microenvironment theory of Trentin and his colleagues, is an important factor controlling the proliferation and differentiation of hemopoietic stem cells. (auth)

11053 (UR-3490-319) INFLUENCE OF X IRRADIATION ON EXPERIMENTAL AUTOALLERGIC SIALADENITIS. White, S. C. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1973. 214p. Dep. NTIS $12.75.

Thesis.

An experimental autoallergic sialadenitis (EAS) of the rat submandibular gland was developed to serve as the standard lesion. Consistently mild or severe lesions of EAS were induced in male Lewis rats when they were immunized with allogeneic submandibular glands from sexually immature or mature female donors, respectively. The glands were homogenized in saline and emulsified in complete Freund's adjuvant and injected into the foot pads. Bordetella pertussis vaccine, a co-adjuvant, was also administered to the same feet. The histopathologic lesions characteristic of the severe form of EAS demonstrated foci of infiltrating mononuclear cells as early as eight days after immunization, extensive mononuclear cell infiltration and parenchymal degeneration from 12 to 21 days, and marked but incomplete recovery from 28 to 56 days. The mild form of EAS showed only foci of infiltrating mononuclear cells at 12 and 21 days after immunization. Induction of either form of EAS results in a marked thymic weight loss (from 8 to 56 days post-immunization), increase in submandibular gland weight during the period of maximal inflammation, and a cessation of body growth (from 8 to 28 days post-immunization). Neither passive transfer of lymphoid cells or serum from immunized animals consistently transferred EAS to histocompatible recipients. Passive transfer of serum from immunized donors to nontreated recipients did, however, result in a loss of thymic weight and inhibition of submandibular gland growth. EAS could be inhibited by prior immunization with allogeneic submandibular glands emulsified in incomplete Freund's adjuvant (without Mycobacterium butyricum). Neck irradiation (1000 R) 7 to 56 days prior to sacrifice induced only occasional inflammatory lesions in the submandibular glands. The weights of both the thymus and submandibular glands were seen to decrease progressively while the body weights continued to rise. Neck irradiation (1000 R) 7 to 56 days prior to sacrifice of animals immunized 7 to 21 days prior to sacrifice to induce mild or severe EAS did not significantly accelerate development of the lesion nor was the intensity of inflammatory lesions significantly modified. In animals with mild or severe EAS which were neck-irradiated, the weights of both the submandibular glands and thymus were found to decrease while the body weight remained relatively unchanged. Administration of EACA epsilon-amino-n-caproic acid (2 minutes before or 6 hours after irradiation) to animals which were neck-irradiated and/or immunized did not significantly modify the intensity of the inflammatory lesions of the submandibular gland, nor did it modify the weight changes seen in the submandibular or thymus gland or whole body. Thus, the influences of neck-irradiation (1000 R) (primarily a progressive submandibular and thymic weight decrease) neither significantly altered nor were altered by the development of the experimental autoallergic lesion of the submandibular gland. Rather, the consequences of the two procedures to these organs appeared to be additive and otherwise essentially independent of each other with respect to both submandibular and thymus glands. (auth)

11054 CYTOLOGICAL CHANGES DURING FRACTIONAL IRRADIATION OF WHITE RATS. Stepanyan, E. D.; Petrosyan, R. A.; Grigorenko, L. P. (Inst. of Zoology, Erevan). Biol. Zh. Arm.; 25: No. 8, 80-84(Aug 1972). (In Russian).

The effects of altering intervals of time and dose of radiation on cytological changes of bone marrow cells and spleen were studied during fractional x irradiation of the organism. White rats were given 100 or 300 R of x rays at 4-, 8-, 12-, or 16-day intervals. The mitotic activity of bone marrow cells increased after a single 100 R dose, but fell after a single 300 R dose. The other variants are evaluated in terms of the nuclear apparatus of the cells of the blood-forming organs. (KSW)

11055 BIOCHEMICAL ASSESSMENT OF THE LEVEL OF EARLY POSTRADIATIONAL CELL DESTRUCTION IN RATS IRRADIATED IN DIFFERENT DOSES. Golyshev, E. P.; Fedorova, T. A. (Inst. of Biophysics, Moscow). Byull. Eksp. Biol. Med.; 75: No. 5, 44-46(May 1973). (In Russian).

A total level of cell destruction in normal and irradiated rats was determined by a radioisotopic biochemical method. The number of cells destroyed in the organism 8 hrs after the irradiation in doses of 100, 300, and 900 R constituted 170, 260, and 630% of the normal level, respectively. (auth)

11056 ROLE OF DIRECT ACTION OF RADIATION IN THE MECHANISM OF DEVELOPMENT OF TUMORS OF THE BREAST. Moskalev, Yu. I. (Inst. of Biophysics, Moscow). Byull. Eksp. Biol. Med.; 75: No. 5, 68-70(May 1973). (In Russian).

A study was made of the role of direct action of radiation in the genesis of tumors of the breast in rats of both sexes. Two series of experiments with x irradiation of the anterior or posterior half of rat body (in doses of 200 to 1000 rad) demonstrated that in the irradiated parts of the body (both in male and female rats) breast tumors appeared much earlier and their incidence was much greater than in the nonirradiated breasts or in control animals. In female animals, tumors of the breast developed much earlier, with lower irradiation doses, and their incidence was greater than in male rats. (auth)

11057 CELL INTERACTIONS BETWEEN HISTOINCOMPATIBLE T AND B LYMPHOCYTES. I. Allogenic Effect by Irradiated Host T Cells on Adoptively Transferred Histoincompatible B Lymphocytes. Hamaoka, T.; Osborne, D. P. Jr.; Katz, D. H. (Harvard Medical School, Boston). J. Exp. Med.; 137: No. 6, 1393-1404(1 Jun 1973).

The adoptive transfer of 2,4-dinitrophenyl (DNP)-keyhole limpet hemocyanin (KLH)-primed lymphocytes into a heavily irradiated allogeneic recipient permits the development of a secondary anti-DNP antibody response to DNP-bovine gamma globulin (BGG) whether or not the irradiated allogeneic host possesses BGG-specific helper T cells. This "allogeneic effect" was demonstrated to result from the capacity of residual, apparently radioresistant, T cells in the irradiated host to exert an active effect on the transferred histoincompatible B lymphocytes. This conclusion derives from two corroborative experiments. In the first, an allogeneic effect was shown to occur on DNP-primed F_1 spleen cells that had been adoptively transferred to irradiated parental recipients; the second experiment demonstrated the development of an allogeneic effect on anti-θ-treated, DNP-specific donor cells transferred to irradiated allogeneic hosts. These results emphasize the extreme caution required in designing and interpreting

experiments that may involve adoptive cell transfers into histoincompatible hosts, and illustrate why such models are unsuitable for investigation of the question of physiologic cooperative interactions between T and B lymphocytes. Suitable approaches are described in the accompanying paper. (auth)

11058 BACTERIAL ENDOCARDITIS IN X-IRRADIATED RATS: EFFECT OF ISOPROTERENOL AND ADRENERGIC RECEPTOR BLOCKING AGENTS. Highman, B. (Armed Forces Inst. of Pathology, Washington, DC); Cyr, W. H.; Streett, R. J. Jr. Res. Commun. Chem. Pathol. Pharmacol.; 5: No. 2, 311-318(Mar 1973).

As reported previously, isoproterenol, a β-adrenergic receptor stimulant causing myocardial ischemia and focal necrosis, augments the susceptibility of x-irradiated rats to endocarditis induced by Streptococcus mitis. To determine if the enhanced susceptibility was due primarily to the myocardial ischemia alone or the resultant myocardial lesions, x-irradiated rats received graded doses of isoproterenol and adrenergic receptor blocking agents. It was found that two doses of 5 mg/kg of isoproterenol, which produced mild or moderate myocardial lesions, augmented susceptibility nearly the same as two doses of 40 mg/kg producing severe lesions. Smaller doses were ineffective. Treatment with 25 mg/kg of propranolol, a β-adrenergic receptor blocking agent, minimized the myocardial lesions and the enhanced susceptibility to endocarditis induced by 5 mg/kg, but not by 40 mg/kg, of isoproterenol. Phenoxybenzamine, an α-adrenergic receptor blocking agent, did not diminish the myocardial lesions or susceptibility. Evidently, the enhanced susceptibility induced by isoproterenol is due to its β-adrenergic receptor stimulation and occurs only when myocardial lesions of at least mild to moderate severity are produced. (auth)

11059 AUDIOGENIC SEIZURE SUSCEPTIBILITY OF RATS X IRRADIATED IN UTERO DURING FIRST ONE-THIRD OF PREGNANCY. Geller, L. M. (Columbia Univ., NY). Exp. Neurol.; 29: No. 2, 268-280(1970).

Groups of Sherman rats were tested for susceptibility to sound-induced seizures at a median age of 175, 230, or 258 days following exposure in utero to a maternal dose of 250 R of x radiation during the first trimester of pregnancy. No significant difference was observed in either number of running attacks or seizures between any irradiated group and control animals of comparable age. Data did not adequately support the suggestion by others of decreased susceptibility in 4-month-old offspring of Sprague-Dawley rats exposed to lower doses of x radiation on gestational day 5 or 10. The importance of the age-at-testing variable in evaluating susceptibility in the prenatally x-irradiated rat, and the need for longitudinal studies in making the determination, are underscored by the well-known differences in audiogenic seizure susceptibility in relation to age in normal animals, evident in the present study. Beyond its special consideration in seizure studies, the variable of test age is of fundamental importance in elaborating the functional consequences of prenatal x irradiation. The already limited number of behavioral changes said to occur in rats surviving x irradiation during the preorganogenetic period is further reduced. (ERB)

11060 EFFECT OF WHOLE-BODY RADIATION AND HYPOXIA ON ERYTHROPOIETIN PRODUCTION IN THE SUBHUMAN PRIMATE TAMARINUS NIGRICOLLIS. Mirand, A. E.; Ambrus, J. L.; Hoffman, J. G.; Murphy, G. P. (Roswell Park Memorial Inst., Buffalo). Res. Commun. Chem. Pathol. Pharmacol.; 5: No. 2, 515-528(Mar 1973).

Erythropoietin production in response to hypoxia induced by 10%-oxygen-containing atmosphere was decreased after whole-body radiation with 600 rads producing less inhibition than 900 rads. Following an early peak in erythropoietin production after exposure to hypoxic conditions (at 48 hrs in controls and 24 hrs in irradiated animals) there was a leveling off with return to baseline values in controls and maintenance of supernormal levels in irradiated animals. This appears to be related to decreased consumption of erythropoietin by irradiated bone marrow and decreased production of red cells, thus less adaptation to hypoxic conditions. In bilaterally nephrectomized animals, there was evidence of extrarenal erythropoietin production in response to hypoxia. This was also decreased, but not eliminated, by whole-body irradiation with 600 rads. The relatively moderate radiation sensitivity of extrarenal erythropoiesis argues against participation of radiation-sensitive elements of the bone marrow or lymphoid system. (auth)

11061 CHANGES IN THE NEUROSECRETORY SYSTEM OF THE FRESHWATER TELEOST ESOMUS DANRICA (HAM.) IN RESPONSE TO IRRADIATION AND THIOUREA TREATMENT. Haider, S.; Sathyanesan, A. G. (Banaras Hindu Univ., India). Strahlentherapie; 145: No. 4, 436-442(1973).

Esomus danrica exposed to 2,000 R whole-body x irradiation exhibited varied changes in the nucleus preopticus (NPO). Some neurons showed degenerative changes, whereas many others were either deeply stained or highly vacuolated. The preoptico-neurohypophysical tract, and the neurohypophysis were swollen with neurosecretory material (NSM). Specimens immersed in ^{131}I exhibited varying quantities of coarse granulation in the NPO neurons. Chromophobic neurons were also encountered. Accumulation of NSM is more in the neurophypophysis than in the tract. Thiourea treated fishes exhibited an initial increase in the stainability of the NPO cells that tends to decrease later. As in ^{131}I-treated specimens, accumulation of NSM is more in the neurohypophysis than along the tracts. (GE)

11062 INFLUENCE OF X RAYS ON ELECTROLYTE SHIFTS AND METABOLISM IN THE MYOCARDIUM. II. Radio-Induced Changes in Potassium and Sodium Concentrations in Isolated Auricle of the Guinea Pig. Pringnitz, R.; Mueller, U.; Hoffmeister, G. (Univ., Marburg, Ger.). Strahlentherapie; 145: No. 4, 427-435 (1973). (In German).

The influence of local irradiation with 3,000 to 20,000 R on ECR, ^{86}Ru transformation, ^{24}Na uptake, and intracellular potassium and sodium concentrations was tested on isolated, electrically stimulated and resting left and right atria. The ECR (defined as [Cr-EDTA]-space) of resting atria increased from 6,000 R upwards with increasing irradiation dose, the intracellular water content significantly decreased at 3,000 R. On electrically stimulated left atria, the ^{86}Rb uptake, 120 min following irradiation with 6,000 R, was augmented as compared with the controls, the dissipation however was slightly inhibited. Moreover, an increase of the ^{24}Na uptake was found under the conditions described. The intracellular potassium content of resting left and right atria after x irradiation with high doses (10,000 R and upwards) decreased significantly. (GE)

11063 INTESTINAL POLYPS ARISING UNDER THE INFLUENCE OF VARIOUS KINDS OF IONIZING RADIATION. Lebedeva, G. A. Vop. Onkol.; 19: No. 4, 47-51(1973). (In Russian).

In experiments on dogs and rats, subjected to the effects of various kinds of radiation, multiple polyps of the bowel were obtained. Following mixed gamma-neutron irradiation or ^{210}Po injection adenomatous polyps of the small intestine developed in dogs. The effect of the incorporated ^{144}Ce in rats resulted in the development of proliferative polyps mostly of the large intestine. The latent period in development of these polyps was 7.5 to 8 years for dogs and 8.3 months for rats. Blastomogenic doses of radiation for each kind of the radiation effect are calculated. (auth)

11064 INFLUENCE OF ACTINOMYCIN D ON THE EARLY POST-IRRADIATION RESTORATION OF CELLS IN THE ORGANISM OF AN IRRADIATED ANIMAL. Konoplyannikov, A. G. (Scientific- Research Inst. of Medical Radiology, Obninsk, USSR). Dokl. Akad. Nauk SSSR; 206: No. 4, 978-984(1 Oct 1972). (In Russian).

A study of post-irradiation cell restoration was conducted using 3.5-month old male mice that were given 400 rad (radiation source not specified) followed by an immediate injection of actinomycin D. At different periods after this treatment the mice were subjected to a second radiation dose (300 rad), and subsequently sacrificed to determine the number of spleen endocolonies. The actinomycin D introduced immediately after the first irradiation weakened the restoration process; restoration in control animals was at a maximum when 9.5 hr elapsed between the first and second irradiations, but this time interval was reduced to 3 hr for animals treated with actinomycin D. (KSW)

11065 LONG-TERM RECOVERY OF CONNECTIVE TISSUE AFTER IRRADIATION. Brown, J. M.; Probert, J. C. (Stanford Univ., CA). Radiology; 108: No. 1, 205-207(Jul 1973).

C3H mice were given either no irradiation or a course of 4,000 or 5,000 rads in 10 fractions over a period of two weeks. Six months later, the right hind legs were given graded doses of 350–700 rads five times a week for two weeks. Analysis of the dose response curves for late necrosis scored eight months later showed that the data were described adequately by the Ellis NSD formula for retreatment of normal tissues. (auth)

11066 MURAL THROMBOSIS OF THE HEART INDUCED BY RADIATION. Brown, J. M.; Fajardo, L. F.; Stewart, J. R. (Stanford Univ., CA). Arch. Pathol.; 96: No. 1, 1-4(Jul 1973).

One hundred eighty male C3H mice were x-irradiated with doses of 1,200 to 4,000 rads to the heart in an attempt to reproduce the radiation lesions seen in humans and rabbits. No deaths specifically attributable to heart disease occurred up to six months after radiation, and histologic examination at this time failed to show the fibrous pericarditis, pericardial exudate, and myocardial fibrosis seen in humans and rabbits irradiated to similar doses. Instead,

these mice developed unexpected mural thrombosis of the ventricles, the extent and organization of which was dose dependent. The absence of pericardial fibrosis at a dose double of that required to produce this lesion in man and rabbits was unexpected. It is speculated that variations in the tissue levels of plasminogen activator might account for this species difference. (auth)

11067 NORMAL TISSUE TOLERANCE TO PARTICLE AND HEAVY ION RADIATION. Lippincott, S. W.; Montour, J. L.; Wilson, J. D.; Bender, R.; Bilek, F. (Virginia Commonwealth Univ., Richmond). Arch. Pathol.; 96: No. 1, 27-32(Jul 1973).

The response of monkey skin to bombardment with charged particles and heavy ions of different linear energy transfer (LET) was investigated to determine normal tissue tolerance. Erythema was selected as the earliest clinicopathologic end point that could be correlated with size of area bombarded, depth-dose pattern, and LET. At 0.9- to 1-mm depth, the lowest dose causing erythema, the earliest postirradiation time of appearance, as well as the average LET in kiloelectron volts per micron were for 180-MeV $^{12}C^{5+}$ (132 keV/μ) 980 rads at three days, for 37-MeV alpha particles (23.5 keV/μ) 980 rads at 13 days, and for 9.2-MeV protons (6.05 keV/μ) 2,040 rads at nine days. Ulceration can be correlated with LET in a similar fashion. (auth)

11068 NEUROSECRETORY ACTIVITY OF THE HYPOTHALAMO-HYPOPHYSEAL AXIS IN CONDITIONS OF TOTAL SHOCK AND CHRONIC X-RAY AND UV IRRADIATION. III. The Amount of Thyreotropic Cells and the Level of Neurosecretion Under the Action of Various X-Ray and UV Doses. Lach, H. (Teacher Training Coll., Krakow). Acta Biol. Cracov., Ser. Zool.; 13: No. 2, 263-278(1970).

The number of thyreotrophic cells and the level of neurosecretion following different doses of uv radiation in the range of 289 to 405 and 254 to 405 nm as well as following single large or chronic doses of x rays were determined. Ultraviolet irradiation of mice during a period of 28 days at doses of 15 and 30 min daily in the determined ranges caused a significant decrease in the number of thyreotrophic cells and an increase in neurosecretory activity in the neural portion of the hypophysis. The same results were observed 7 and 14 days following single large as well as chronic doses of x radiation. At 21 and 28 days following exposure, an increase in the number of thyreotrophic cells was observed with a simultaneous decrease in the level of neurosecretion. At the same time, a certain interdependence between the number of thyreotrophic cells and the level of neurosecretion was observed under the defined irradiation conditions. (ERB)

11069 HEMATOLOGICAL CHANGES DURING CONTINUOUS γ IRRADIATION. Praslicka, M.; Chlebovsky, O. (Inst. of General Biology, Kosice, Czech.). Radiobiol. Radiother.; 14: No. 2, 213-217(1973).

The hematological changes in rats continuously irradiated by daily exposure rates of 5 to 67 R were investigated. After a significant initial decrease in agranulocytes, at the exposure rates 5 R/day a mild increase and at 10 and 16 R/day a steady state takes place. At the exposure rates of 27 to 67 R/day agranulocytes fall up to the values 20 to 40% as compared with the state before irradiation and remain at these steady state values till the end of irradiation. There are no statistically significant changes in granulocyte and erythrocyte counts at the exposure rates used. The values of platelets decrease at exposure rates of 20 and 53 R/day to a minimum on the 60th and 40th day of irradiation and then a mild increase can be observed. (auth)

11070 CHROMOSOMAL CHANGES IN THE BONE MARROW OF MICE AFTER ONE SINGLE WHOLE-BODY X IRRADIATION. Grigoroff, L. A.; Gensicke, F. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Radiobiol.-Radiother.; 14: No. 2, 177-189(1973). (In German).

The cytogenetic examinations of bone-marrow cells after the effect of ionizing radiation at present show only a limited, experimentally assured possibility of use with respect to biological dosimetry. In the present paper the type and number of chromosomal changes in the bone-marrow cells is examined with 12 months old mice after a single x irradiation in dependence on the dose, dose rate, and time after irradiation. The animals' bone-marrow was processed according to a method by Ford and Hamerton that was modified by us. The results show a relation of the effect between the dose and the number of cells with aberrations and breaks, respectively, per cell. The dicentric chromosomes especially increase with increasing dose. An influence of the dose rate (9.6 R/min and 48 R/min) could not be observed. With increasing time after irradiation, a reduction of all chromosomal changes is to be found, the stable aberrations not as highly decreasing as the unstable ones. The present results show in the range of 100 to 300 R in logarithmic representation (log/log) an approximately linear increase of the dicentric chromosomes. Further examinations are necessary in order to come to an eventual quantitative statement on the accumulated dose by means of the detection of these chromosomal pictures of damage. (auth)

11071 EFFECT OF THE JOINT ACTION OF X RADIATION AND IMMUNODEPRESSORS ON THE MORPHOLOGICAL CHANGES OF BLOOD CELLS AND BONE MARROW. Ter-Avetisyan, A. T.; Kogan, Z. Yu. Biol. Zh. Arm.; 25: No. 9, 54-58(Sep 1972). (In Russian).

The morphological changes of cells of peripheral blood and bone marrow were studied during the combined action of x-radiation and cytostatic agents. Rats and mice were irradiated with x-rays and divided into several groups, to which were administered: anti-lymphocytic serum, trimetan, thiophosphamide, and combinations of pair of these, methyl ester of 4-bromo-phenylacetic acid, and 2-alkoxy-5-bromobenzyl-bis(β-chloroethylamine). The results showed that the joint action of x radiation, cytotoxins, and their various combinations resulted in a depressing effect on the number of leukocytes in all experimental groups. (KSW)

11072 RADIO-PROTECTIVE EFFECT OF AET AND SEROTONIN ON GROWING RATS EXPOSED TO FRACTIONAL SMALL-DOSE X IRRADIATION. Nikolov, I. T.; Baev, I. A. Sci. Pub., Res. Inst. Radiol. Radiat. Hyg.; 4: 19-25(1968).

The ability of AET and serotonin to protect young growing rats following fractionated sublethal x irradiation was investigated. The results indicated that AET manifests a protective effect in the case of fractionated sublethal irradiation of growing rats (using body weight as the criterion). Serotonin had no protective effect with respect to growth. (ERB)

Invertebrates

11073 EFFECT OF WHOLE BODY X-IRRADIATION ON THE PARS INTERCEREBRALIS CELLS OF THE GRASSHOPPER, ACRIDA GIGANTEA. Adak, T.; Banerjee, S. K. (Kalyani Univ., India). Sci. Cult. (Calcutta); 38: No. 10, 454-455(Oct 1972).

The effect of whole-body x irradiation at a single low dose on the cytomorphology of the pars intercerebralis cells of the nymph and adult grasshopper Acrida gigantea Hbst. is reported. It was determined that an x-ray dose as low as 99R acted as a stress stimulus that induced depletion of the aldehyde fuchsin-stained cytoplasmic inclusions in the pars intercerebralis cells of the grasshopper in varying degrees. (ERB)

11074 IMMUNOSUPPRESSION AND INCREASED SUSCEPTIBILITY TO JAPANESES B ENCEPHALITIS VIRUS IN TRICHINELLA SPIRALIS INFECTED MICE. Cypess, R. H.; Lubiniecki, A. S.; Hammon, W. McD. (Univ. of Pittsburgh). Proc. Soc. Exp. Biol. Med.; 143: No. 2, 469-473(Jun 1973).

Infection with T. spiralis larvae greatly increased the susceptibility of mature mice to fatal CNS disease when challenged peripherally with JBE virus 7 days after administration of larvae. By 28 days following T. spiralis infection, susceptibility to JBE virus returned to control levels. This parasite caused a suppression of the neutralizing and complement-fixing antibody responses to JBE virus, whether challenged at 7 or 28 days. In contrast, infection with N. dubius larvae, or irradiated larvae of either parasite, had no effect on susceptibility or antibody responses to virus. Evidence of T. spiralis larval migration into the brains of infected mice was not observed. Increased corticosteroid hormone levels, suppression of the humoral antibody response, or changes in fixed macrophage phagocytic activity did not appear to constitute potential mechanisms for the increased susceptibility of T. spiralis-infected mice to JBE virus. (auth)

11075 MODIFICATION OF RADIATION-INDUCED GENETIC DAMAGE IN THE MALE GERM CELLS OF DROSOPHILA MELANOGASTER WITH PYRIMIDINE NUCLEOSIDES AND THEIR HALOGENATED ANALOGUES: EFFECTS ON THE F_1 GENERATION. Rajaraman, R.; Kamra, O. P. (Dalhousie Univ., Halifax, N. S.). Mutat. Res.; 17: No. 3, 395-401(Mar 1973).

Using standard techniques of genetic analysis, the phenomena of mutagenicity and radiosensitization by the halogenated pyrimidine analogues BUdR and BCdR were investigated in detail in the different stages of the male germ cells of Drosophila melanogaster. The effects of BUdR and BCdR on the F_1 offspring of the treated males are reported. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstract 10870.

11076 (ORO-2401-73) RADIOISOTOPE STUDIES UTILIZING A LOW LEVEL WHOLE-BODY COUNTER AND CLINICAL APPLICATIONS OF ACTIVATION ANALYSIS. Comprehensive Report, 1957-1973. Brill, A. B. (Vanderbilt Univ., Nashville, Tenn. Dept. of Radiology). 30 Apr 1973. Contract AT(40-1)-2401. 87p. Dep. NTIS $6.50.

Methods were developed for measuring the distribution of radioactivity in patients following radionuclide administration using two opposed Geiger-Mueller counters. Calibration studies were carried out in phantoms using a LiF thermoluminescent dosimeter and ^{99m}Tc sources ranging from human kidney to liver size. Progress is reported in the development of a computerized radionuclide data acquisition, processing, and display system (CAMAC) and also a computerized image display system (PEP) to flag regions of interest during radionuclide scanning. Methods were also developed for reducing the radiation dose to patients during scanning using computer analysis of the photon energy spectrum with corrections for scatter. Estimations were made of the radiation dose to patients following the administration of tracer doses of ^{111}In-DTPA for measurements of cerebrospinal fluid flow dynamics, ^{99m}Tc polyphosphate for bone scanning, ^{131}I-iodocholesterol for adrenal scanning, and ^{206}Bi for brain scanning. Whole-body counting combined with radiometric analysis of urine, feces, and blood samples were used to estimate the radiation dose to patients with osteoporosis and Pagets' disease following the administration of tracer doses of ^{47}Ca for bone scanning. A method was developed for whole-body transmission scanning of patients for use in measurements of bone mineral content. The method uses a combination of ^{125}I and ^{131}I sources and the availability of two photons of different energy makes it possible to carry out both bone and soft tissue determinations simultaneously. The ^{125}I transmission technique was also used to study the healing rates of bone fractures. Whole-body counting of natural ^{40}K was used to estimate the relative loss of lean body mass and fat in obese patients following jejuno-ileal bypass surgery. Whole-body counting was also used to measure the content of fallout ^{137}Cs in man residing in Tennessee during 1972 and 1973. Preliminary studies were made on the feasibility of using ^{252}Cf as on-site neutron sources for clinical studies of sample composition and stable tracer kinetics using neutron activation techniques. (CH)

11077 CUMULATIVE RADIATION EFFECT. Pt. 3. Continuous Radiation Therapy: Short-Lived Sources. Kirk, J.; Gray, W. M.; Watson, E. R. (Western Regional Hospital Board, Glasgow). Clin. Radiol.; 24: No. 1, 1-11(Jan 1973).

In two previous papers, (Kirk, J. et al., Clin. Radiol. 22: 144 (1971) and Clin. Radiol. 23: 93 (1972)), a scale of accumulated sub-tolerance radiation damage, the Cumulative Radiation Effect (CRE), was described for fractionated treatment regimes and continuous radiation therapy from long-lived sources. This scale provides a means of assessing and comparing the biological effects of various treatments. The concept of the CRE is extended to include damage to normal connective tissue for continuous radiation from short-lived sources, whose dose rates change considerably during the course of treatment. In particular, the method of assessing the biological damage resulting from radiation by a source whose change in dose rate can be approximated by an exponential decay is described. The application of the CRE to radiation therapy by short-lived sources is described for treatments given as implants or by external applicators and maintained either for a finite time or to infinity. Examples of calculations for treatments with several isotopes are given (Rn, Ra, Au^{198}). It is suggested that the results of these may be considered as predictions to be verified or criticized on the grounds of experience, and offer a possible test of the validity of the analysis leading to the expression for the CRE achieved by short-lived isotopes. (auth)

11078 LATE CLINICAL AND ROENTGEN OBSERVATIONS FOLLOWING THOROTRAST ADMINISTRATION. Gondos, B. (District of Columbia General Hospital, Washington, DC). Clin. Radiol.; 24: No. 2, 195-203(Apr 1973).

Nineteen cases of Thorotrast disease with well documented roentgenographic manifestations are reviewed. Two patients had Thorotrast granuloma. One of these had an associated vocal cord paralysis, the other one resulted in a hemorrhage from the internal carotid artery. Other associated diseases observed were: multiple myeloma, hepatoma (cholangiocarcinoma?), and lymphosarcoma. The two last mentioned cases and the case of Thorotrast granuloma complicated with hemorrhage are discussed in detail. (auth)

11079 RADIATION DOSES FROM THOROTRAST MYELOGRAPHY. Molla, M. A. R. Toronto; Univ. of Toronto (1971). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The radiation doses resulting from thorotrast, a colloidal suspension of $^{232}ThO_2$ to the cauda equina and other organs of a group of humans who received thorotrast for myelography (1940 to 41) were estimated. Most of the subjects studied were found to have developed cauda equina myelopathy within 2 to 20 yrs (average time of 11 yrs) of myelography. The doses are calculated from a knowledge of three parameters: (1) the thorium body burdens, (2) the distribution and concentration of thorium and its daughters in different organs as a function of time, and (3) the excretion rates of thorium and daughters from the body. Information on (2) and (3) above was obtained from a series of experiments carried out with dogs. The distributions and concentrations of thorium and daughters amongst various organs of the humans were assumed to be identical to the mean observed values in the corresponding organs of the dogs. The estimated doses to the cauda equina of 550 days dogs range between 3000 and 7000 rems and the histological studies of these specimens showed arachnoiditis, degeneration of the axons, and mild damage to the blood vessels though the dogs did not show any clinical effect. The thorium body burdens in humans who had had the thorotrast myelography were 0.03 to 1.0 gm with an average of 0.46 gm. Based on this and the dog studies, the radiation doses to the human cauda equina by 11 yrs are estimated to be within the range of 3500 to 60,000 rems depending on the thorium body burdens. The histological studies of the cauda equina of the humans revealed arachnoiditis, extensive degeneration of the axons, and damage to the blood vessels with proliferative and degenerative changes. (ERB)

11080 RADIATION DECONTAMINATION FACILITY FOR THE COMMUNITY HOSPITAL. Kelly, F. J.; Lemons, B. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX). J. Occup. Med.; 14: No. 12, 904-907(Dec 1972).

There are four general types of radiation-accident patients likely to be encountered in the community hospital. These include patients with internal radioactive contamination but essentially no contamination of the skin surface; patients exposed to an external source of radiation without contamination of the body or skin; patients with internal or skin contamination and an open wound, and patients with skin contamination and possible internal contamination by inhalation, absorption, or ingestion. In 1967 a U.S. Atomic Energy Commission (AEC) study indicated the need for improving local facilities as well as greater involvement and expertise at the community hospital level. Some of the reasons for the need for special provisions and the steps to be taken are outlined and the first decontamination facility designed exclusively for handling radiation casualties in a community hospital is described. (CH)

Animals

11081 (BNWL-1750(Pt.2), pp 6.8-6.11) SUPPRESSION OF IMMUNE CAPACITY IN RAINBOW TROUT SUBLETHALLY IRRADIATED DURING EMBRYOGENESIS. Strand, J. A.; Fujihara, M. P. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

Data are reported on the incidence of Chondrococcus columnaris infections in rainbow trout sublethally exposed to tritiated water β particles during embryogenesis. Both one-year sub-adult and two-year adult trout demonstrated significantly lowered antibody titers after their second and third antigenic stimulus to C. columnaris than did controls. Results of agglutination tests indicate that immune capacity was permanently altered by irradiation during embryogenesis. (CH)

11082 (COO-3380-9) CONSIDERATIONS RELATING TO THE FORMULATION OF LIMITS FOR UNAVOIDABLE POPULATION EXPOSURES TO ENVIRONMENTAL CARCINOGENS. Albert, R. E.; Altshuler, B. (New York Univ., N. Y. Inst. of Environmental Medicine). 12 Jul 1972. 41p. (CONF-720505-5). Dep. NTIS $4.25.

From 12th Hanford biology symposium on radionuclide carcinogenesis; Richland, Washington, USA (11 May 1972).

The osteogenic sarcoma response in CF_1 female mice to single i.v. exposures at age 70 days to ^{226}Ra bromide provided a basis for the assessment of chronic exposures to ionizing radiation. Although the exposures were acute, the persistence of radium in the skeleton produces sustained exposure. The cumulative osteosarcoma single-risk incidence (i.e., adjusted for survival) is shown on a probability scale plotted against the log of age at death in 30 day intervals from the time of ^{226}Ra injections. Incidence was lognormal with respect to time for each of the six dose levels ranging from 0.05 μc/kg to 120 μc/kg. Data on the relation of cigarette smoking and mortality among 293,000 U. S. veterans was also examined. This study provided age-specific death rates for lung cancer according to several levels of cigarette consumption. (CH)

11083 PROLIFERATIVE ACTIVITY OF GASTRIC MUCOSA IN RATS AFTER ORAL ADMINISTRATION OF RADON WATER

AT VARIOUS POSTRESECTION PERIODS. Zaporozhchenko, I. G. (Inst. of Human Morphology, Moscow). Byull. Eksp. Biol. Med.; 75: No. 5, 89-93(May 1973). (In Russian).

A 50% resection of the gastric fundus was carried out in adult rats. At various periods after the operation, common tap water or water with different radon concentration was administered into the stomach. One month after the resection there was noted a distinct reduction in the 24-hour amount of DNA-synthesizing cells in the gastric mucosa of the operated control rats. Four and 6 months after the operation this index failed to differ from the normal. Administration of radon water to the operated animals produced a stimulating effect or a depressive action on DNA synthesis in the glandular cells, depending on the postoperative periods and water radon content. (auth)

11084 QUANTITY AND DURATION OF GENETIC DAMAGE IN MICE CAUSED BY RADIOACTIVE ISOTOPES INCORPORATED DURING FETAL DEVELOPMENT. Baev, I. A. Sci. Pub., Res. Inst. Radiol. Radiat. Hyg.; 4: 9-18(1968).

The effects of ^{89}Sr, ^{131}I, and ^{32}P, incorporated in mice on the 12th day of fetal development, on the hereditary fitness of the progeny in six successive generations under outbreeding conditions were studied. Results are discussed in terms of reproductive capability of progeny populations, stillbirths and postnatal lethality following fetal incorporation, and average body weight and incidence of nanism in progeny. It was shown that irradiation of both parents by incorporation of radioisotopes during fetal development resulted in a considerable reduction of the hereditary fitness that persisted for a number of successive generations. (ERB)

11085 CYTOGENETIC STUDIES OF MEIOTIC CHROMOSOMES (DIAKINESIS-METAPHASE I) OF MALE MICE WITH IODINE-131 DURING THEIR FETAL PERIOD. Bairakova, A. K. Sci. Pub., Res. Inst. Radiol. Radiat. Hyg.; 4: 5-8(1968).

The character and incidence of chromosome aberrations in the primary spermatocytes in diakinesis-metaphase I of sexually mature mice treated with ^{131}I during their fetal period were studied. The results obtained show that the chromosome aberrations appear in the primary germ cells as a result of the ^{131}I treatment. Chromosome aberrations were revealed in 10.12% of all analyzed cells. (ERB)

Nuclide Kinetics and Toxicology

11086 STRONTIUM CONTENT OF BONES AND TEETH OF HUMAN FOETUSES. Wolf, N.; Gedalia, I.; Yariv, S.; Zuckermann, H. (Hebrew Univ., Jerusalem). Arch. Oral Biol.; 18: 233-238(Feb 1973).

The concentration of strontium was determined in bone and teeth ash of human fetuses 5 to 9 months old from regions with different water supplies (Beer-Sheva, Jerusalem, and Tel-Aviv). The material was collected about 8 yr ago. Strontium was detected in the femoral and mandibular bones as early as the fifth month of fetal development (the earliest age for which material was available) and the concentrations were similar in all areas. The strontium concentration increased significantly from the 5th to the 7th month in the bone ash of the fetuses from the Beer-Sheva area, but no such increase with age was found in fetuses from the Tel-Aviv area. The concentration of strontium in the bone ash of 7 to 9 months old fetuses from Jerusalem was similar to that in fetuses of corresponding age from the Tel-Aviv area. The concentration of strontium in the tooth ash of 7 to 9 months old fetuses of each area was similar to and paralleled that of the bones of a corresponding age. It is suggested that the differences between the strontium concentrations of the hard tissues of the fetuses in the Beer-Sheva area on the one hand and the Tel-Aviv and Jerusalem areas on the other are due to differences in the strontium contents of the drinking water supplied during pregnancy. Present drinking water sources, some of which were in use at the time the material was collected, have a higher strontium content in the Beer-Sheva area than in the Tel-Aviv and Jerusalem areas. (auth)

Man

Refer also to abstracts 10866, 10875, 11076, 11079, 11080, and 11082.

11087 (AAEC/LIB/Bib-373) HUMAN EXPOSURE TO URANIUM. A Bibliography. Newland, E. A. (comp.). (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan 1973. 85p. Dep. NTIS (U. S. Sales Only) $6.25.

Four hundred and eight references on human exposure to uranium are listed. The period covered by the bibliography is 1948 to 1972 and reference is made to an abstract for each citation. References on experimental studies on animals are included. (AT)

11088 (BNWL-1750(Pt.2), pp 8.1-8.2) FALLOUT RADIONUCLIDES IN NORTHERN ALASKAN ECOSYSTEMS. O'Farrell, T. P.; Hedlund, J. D.; Sweany, H. A. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

Studies of the fate and effects of fallout radionuclides in natural ecosystems of northern Alaska were continued for the eleventh consecutive year. An important part of the study was the measurement of ^{137}Cs body burdens of the Eskimos living at Anaktuvuk Pass. The body burdens appear to be stabilizing at an annual level of 300 nCi which may indicate that fresh fallout is balancing the decrease in activity observed since the peak of 1964. A significant benchmark was achieved with the completion of an updated computer storage and retrieval system for all of the Alaskan data gathered for the past 11 years. The program will facilitate retrieval and cross-referencing of all past measurements, and it will also permit review of our inventory of old, stored samples that may prove to be valuable for more modern analyses. (auth)

11089 (COO-3011-2) RADIOACTIVE FOODCHAINS IN THE SUBARCTIC ENVIRONMENT. Summary Report for the Period August 15, 1970-August 14, 1973. Miettinen, J. K. (Helsinki Univ. (Finland). Dept. of Radiochemistry). May 1972. Contract AT(11-1)-3011. 24p. Dep. NTIS $3.25.

The dietary survey carried out in Inari during 1971 showed that a change had taken place in the seasonal pattern of reindeer meat consumption of the reindeer-herding Lapps in Finland. Approximately every third Lapp household acquired a deep-freezer recently, most of them between 1969-71. Because of this, the previously high consumption of reindeer meat during the winter months had decreased, while the consumption during summer had increased, the winter meat now being consumed throughout the summer to the next slaughtering period in autumn. While there is practically no change in the total amount of meat consumed annually, the change in the kind of meat and the time of its consumption have diminished the seasonal variation of the ^{137}Cs body burden. During 1972 and 1973 the amount of fresh fallout was low and the seasonal pattern of reindeer meat consumption of the Inari and Utsjoki Lapps has probably not changed any more. Thus, the previous decrease rate of the body burden, 16% per year, has again been measured by whole-body counting. Results are also reported from studies on the accumulation and the rate of elimination of ^{55}Fe in lichens, reindeer, and man, and studies on the content of ^{210}Po, ^{210}Pb, and stable lead in the atmosphere and aquatic and terrestrial food chains. (CH)

11090 (NIRS-RSD-34, pp 8-12) STRONTIUM-90 IN HUMAN DECIDUOUS TEETH. Feb 1972.

In radioactivity survey data in Japan.

The National Institute of Health has determined the ^{90}Sr content in human deciduous teeth, as an index of the accumulation of radioactivity in children, since 1961. About 92,400 human deciduous teeth have been collected from various areas in Japan for ten years. Teeth of children in 3 areas were subjected to the analysis. One sample was sufficient to be of 50 to 70 incisors and of 30 to 50 molars for teeth from children born between 1958 and 1964. The results of ^{90}Sr content of teeth from children born during the period 1948 to 1964 in the Kanto District are shown. The results obtained during the period 1950 to 1964 in the Tokai District are also shown. The results during the period 1957 to 1963 in the Hokuriku District are shown in the table and the figure. (auth)

11091 METABOLISM OF CESIUM-137 AND STABLE POTASSIUM IN MAN. Keslev, D. D.; Boyadzhiev, A. A.; Novakova, E. T.; Kerteva, A. A.; Yakumov, L. Kh. Sci. Pub., Res. Inst. Radiol. Radiat. Hyg.; 4: 85-91(1968).

The possibility of estimating and assessing the body burden of ^{137}Cs in different age groups using daily urinary and fecal excretion data was established. Urinary data was more useful for this purpose than fecal data. No correlation was established between ^{137}Cs excretion and potassium excretion. (ERB)

Animals

Refer also to abstracts 10852, 10877, 10882, 11063, and 12507.

11092 (BNWL-1750(Pt.2), pp 3.3-3.6) EFFECTS OF SHORT RANGE PARTICLE IRRADIATION ON EMBRYOGENESIS OF MARINE TELEOST FISH: LOW DOSE EFFECT OF TRITIUM ON EGGS AND LARVAE OF PACIFIC OYSTER, CRASSOSTREA GIGAS. Uchiyama, M. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

The effects of low levels of tritium in seawater on the embryo-

genesis of the eggs and larvae of the Pacific oysters (Crassostrea gigas), which is the most important commercial bivalve in the Pacific Northwest, were studied. Eggs were spawned artificially in the laboratory, and immediately after fertilization the eggs were transferred into beakers with 300 ml of seawater containing 0.01, 0.1 and 1.0 μCi/ml of tritium. The salinity was 27 and temperature was maintained at 20 to 22°C. The development of eggs under these conditions could not be compared with that of eggs in natural conditions. No significant differences were observed in larvae reared in the three levels of tritium concentration. (CH)

11093 (BNWL-SA-4710) SYSTEM FOR SEPARATING EXPIRED FROM INSPIRED AEROSOL DURING THE INHALATION EXPOSURE OF BEAGLE DOGS. Craig, D. K.; Decker, J. R.; Herring, J. P. [nd]. 5p. (CONF-730527-1). Dep. NTIS $3.00.

From lung morphology conference; Albuquerque, New Mexico, USA (7 May 1973).

A two-way valving system was designed to separate expired from inspired air as an integral part of the venturi used to measure a dog's respiration parameters during aerosol inhalation exposures. The exhaled air is collected in a 30-liter meteorological balloon, from which a cascade impactor sample can be drawn while the dog is being exposed. Three female beagles were exposed three times to ^{198}Au labeled gold aerosols ($T_{\frac{1}{2}}$ = 2.7 days) using this system. Filter paper and cascade impactor samples were used to analyze the inhaled and exhaled aerosol. Total activity in the balloon air was added to activity deposited in the balloon and the exhaust plumbing to obtain the total exhaled activity. Activity retained in the dogs was assessed in a thorax counter 2, 8, and 15 to 16 days postexposure. All excreta were collected and analyzed for this period, enabling estimates to be made of both total initial deposition (activity retained + activity excreted) and probably alveolar deposition of inhaled ^{198}Au. (CH)

11094 (CEA-R-4416) PHYSICO-CHEMICAL STATE OF THE LANTHANIDES CERIUM 144 AND THULIUM 170, INTRODUCED AS DISSOCIATED SALTS AT ACID pH IN THE RAT PLASMA. Masse, R.; Arnoux, B.; L'Hullier, I.; Lafuma, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jun 1973. 22p. (In French). Dep. NTIS (U.S. Sales Only) $3.25.

The binding of ^{144}Ce and ^{170}Tm to proteins is not specific, and the level of binding is very high for both nuclides; ^{144}Ce is bound with proteins into unstable aggregates, whereas ^{170}Tm is not. Small pH changes below the physiological pH unbind free ^{144}Ce from these proteinic associations whereas ^{170}Tm remains strongly bound. The part played by these processes in the liver uptake of both rare earths following injection into rats is analyzed. (auth)

11095 (CEA-R-4431) STUDY OF THE EARLY LUNG CLEARANCE OF LANTHANUM 140. Pasquier, C. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). May 1973. 150p. (In French). Dep. NTIS (U.S. Sales Only) $9.50.

Thesis.

Lanthanum-140 distribution in the lung was studied using three techniques. The conditions of the polymerization of lanthanum in solutions were defined by millipore filtration. The maximum polymerization was reached at 10^{-4} M and always remained below 50 per cent. Following the contamination of the deeper lung of macacus monkeys by inhalation of ^{140}La-labeled aerosols, clearance was followed by external counting. There was no evidence of an early spontaneous transfer, and under the influence of DTPA there remained a residual fraction, whose characteristics were investigated. The biochemical study of the alveolar lining layer and its characteristics for the uptake of lanthanum showed the influence of a lipo-proteic complex. The whole of the investigations allowed the development of a model of the early binding of lanthanum in the alveolar tissues. (CH)

11096 (LF-tr-60) EXPERIMENTAL RESEARCH ON THE TREATMENT OF CONTAMINATION BY THE TRANSPLUTONIANS. Lafuma, J.; Nenot, J. C.; Morin, M. 1970. Translated by R. Ruffy (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). from pp 249-257 of EUR-4612. 7p. Dep. NTIS $3.00.

Saline solutions of ^{239}Pu, ^{238}Pu, ^{241}Am, and ^{242}Cm were administered by intramuscular injection and by inhalation in the form of aerosols to Sprague Dawley rats (SPF) for research purposes. The diffusion in the organism of quantities injected intramuscularly was studied as a function of time, together with the activity distribution in the skeleton, urinary system, liver, and feces. A fraction of ^{241}Am and a still larger fraction of ^{238}Pu remained in the blood and the muscles. Next was studied the metabolism of the inhaled activity fraction, which was insolubilized in the air cells of the lungs and eliminated in the bones and urinary system. The greater solubilization of Am and Cm was observed, and also the elimination of Pu from the lung by the trachea and the feces. Therapeutic studies were carried out in two directions: general decontamination and decontamination of the skeleton. Treatments were performed with sodium DTPA at pH 5, administered either by intramuscular injection or by inhalation of aerosols. The results showed the effectiveness of the treatment in the prevention of bone accumulations. (auth)

11097 RETENTION OF ^{210}Pb IN BEAGLE DOGS. Hursh, J. B. (Univ. of Rochester, NY). Health Phys.; 25: No. 1, 29-35(Jul 1973).

Four adult beagle dogs were injected intravenously with 11 to 26 μCi of ^{210}Pb cleared of ^{210}Po. The retention of ^{210}Pb was followed by in vivo gamma counting and by the collection and analysis of excreta. The effective half-lives for the slowest time constant component of a four-term exponential sum retention equation was 815 days based on the in vivo counting results and 1940 days based on the analysis of excreta. It was found that from 56 to 71% of the lead excretion occurred via the fecal route after the first few days. Lead content of blood was measured and retention in the blood was expressed in a series of exponential terms. (auth)

11098 ASSOCIATION OF ^{210}Pb WITH CONSTITUENTS OF ERYTHROCYTES. Bruenger, F. W. (Univ. of Utah, Salt Lake City); Stevens, W.; Stover, B. J. Health Phys.; 25: No. 1, 37-42(Jul 1973).

Interaction of ^{210}Pb of high specific activity with constituents of blood was investigated. In-vivo experiments using ^{210}Pb were performed in beagles and in-vitro studies were done with human and canine whole blood and isolated blood cells. About 90% of the nuclide found with red cells was associated with cytoplasm and less than 10% was bound to the stroma. Transfer of ^{210}Pb across the red cell membrane did not require the presence of plasma proteins. Gel electrophoresis of red cell cytoplasm showed that most of the ^{210}Pb was present in the fractions that also contained hemoglobin (Hb). In the dog, varying amounts were also found in fractions that had electrophoretic mobilities greater than hemoglobin. The HbA_2 ($\alpha_2\delta_2$) component of fresh human hemoglobin had a much higher affinity for ^{210}Pb than the main HbA ($\alpha_2\beta_2$) fraction. When stable lead was added to the ^{210}Pb, the HbA_2 component was saturated, and a larger fraction of the lead was found with the main hemoglobin, HbA. Small amounts of ^{210}Pb were also found with erythrocuprein. (auth)

11099 STRONTIUM-CALCIUM DISCRIMINATION DURING PLACENTAL TRANSFER AND FETAL UPTAKE IN RATS: EFFECT OF GESTATION DURATION. Hartsook, E. W.; Hershberger, T. V. (Pennsylvania State Univ., University Park). Proc. Soc. Exp. Biol. Med.; 143: No. 2, 343-349(Jun 1973).

Twenty-eight female rats, receiving 10 or 22% casein diets, were given iv doses of ^{89}Sr and ^{45}Ca proportional to body weight on either day 13, 15, 16, 17, 18, 19, 20 or 21 of gestation. One day after dosing, ^{89}Sr and ^{45}Ca contents of fetuses, placentas, maternal carcass and GI tract contents were determined along with 24-hr urine and feces content. Dietary protein percentages had no significant effect on any experimental criterion. Pooled data for both diets showed uptake by placental structures of 0.36 and 0.27% of the ^{89}Sr dose and 0.41 and 0.23% of the ^{45}Ca dose at 13 and 21 days gestation, respectively. Parallel values for fetal uptake were 0.11 and 12.91% of the ^{89}Sr dose and 0.14 and 20.20% of the ^{45}Ca dose, respectively. The strontium-calcium discrimination [i.e., ^{89}Sr : ^{45}Ca ratio, or observed ratio (OR)] evident in placental structures, total fetuses and between fetuses and maternal carcasses changed curvilinearly with days duration of gestation (T) according to these regression equations: $OR_P = 4.348 - 0.483T + 0.016T^2$, $OR_F = 4.397 - 0.444T + 0.013T^2$, and $OR_{F/M} = 5.77 - 0.585T + 0.016T^2$; where OR_P, OR_F, and OR_M are the ^{89}Sr: ^{45}Ca ratios of placental structures, fetuses, and maternal carcass, respectively, and $OR_{F/M}$ is OR_F/OR_M. (auth)

11100 EFFECT OF FERROCYANIDES ON THE ELIMINATION OF RADIOCESIUM IN PIGS. Havlicek, F.; Hrusovsky, J. (Military Research Inst. of Veterinary Medicine, Prague). Vet. Med. (Prague); 18: No. 2, 111-116(Feb 1973). (In Czech).

Trials were conducted in swine to study the effect of the peroral application of ferrocyanides (potassium cyanoferrate and ferric potassium ferrocyanide) on the elimination of ^{134}Cs applied by the peroral or intratracheal methods. Both ferrocyanides used in the trial show high decontaminating effect in single or repeated applications of the doses of 320 mgs per 1 kg of the weight of the animal. The mechanism of the effect of the two ferrocyanides is being discussed. (auth)

11101 STUDIES OF IODINE-131 KINETICS IN THE LABORATORY MOUSE. Part I. Radioactive Iodine Kinetics Following Oral Administration to Sexually Mature Nonpregnant and Pregnant Animals. Vasilev, G.; Bairakova, A.; Filev, G. Sci. Pub., Res. Inst. Radiol. Radiat. Hyg.; 4: 27-34(1968).

Aqueous solutions of ^{131}I (sodium iodide) were administered to pregnant and nonpregnant sexually mature mice at a dose of 125 ± 10 μCi by gastric intubation. The kinetics of the radioisotope were determined as the time-change relationship of activity in the whole body and the various organs including thyroid, stomach, small intestine, urinary bladder, blood, and urine. No difference was found between pregnant and nonpregnant mice in relation to the kinetics. (ERB)

11102 STUDIES OF IODINE-131 KINETICS IN THE LABORATORY MOUSE. Part II. Radioactive Iodine Kinetics in Fetus and Newborn Following Oral Administration to Pregnant Mice. Vasilev, G.; Bairakova, A.; Filev, G. Sci. Pub., Res. Inst. Radiol. Radiat. Hyg.; 4: 35-41(1968).

The changes of fetal and neonatal radioactivity following a single oral administration of 125 μCi of ^{131}I to pregnant mice on the 12th or 16th day of gestation, i.e., prior to and after the formation of a functional thyroid gland in the fetus were studied. Also, the distribution of ^{131}I in the neonatal organism and the quantity of ^{131}I supplied by the mother's milk were determined. The complexity of the maternal-fetal system and its effects on ^{131}I kinetics in the fetus are discussed. The results indicate that the major portion of neonatal activity was due to the ^{131}I in the thyroid gland. (ERB)

11103 COMBINED USE OF ION-EXCHANGE RESINS AND OSMOTIC DIURESIS TO REDUCE IODINE-131 CONCENTRATION IN CRITICAL ORGANS. Nikolov, I. T.; Bokova, N. V.; Kiradzhiev, G. D. Sci. Pub., Res. Inst. Radiol. Radiat. Hyg.; 4: 43-50(1968).

The following conclusions were drawn from the experimental results. The single administration of Dowex-21K anionite resin was the most effective out of three schemes proposed to reduce iodine-131 concentration in the critical organs. The individual application of mannitol to provoke osmotic diuresis did not reduce iodine-131 concentration, and its combination with Dowex-21K diminished the effect achieved when the resin was individually administered. The effective period of half-excretion in the interval 2 to 8 hrs following iodine-131 administration was prolonged in all test groups, compared to the control group, but in the subsequent periods it decreased, in comparison to the controls, especially in the group treated with Dowex-21K 10 min after iodine-131 administration. (ERB)

11104 ACCELERATED EXCRETION OF RADIOACTIVE IODINE BY MEANS OF SOME PHARMACOLOGICAL SUBSTANCES. Mikhailov, M. A.; Pavlova, V. B. Sci. Pub., Res. Inst. Radiol. Radiat. Hyg.; 4: 51-56(1968).

The effectiveness of various diuretics, potassium iodide, potassium perchlorate, and different combinations of these substances for accelerating the excretion of ^{131}I following oral administration was studied in rats. Individually, the agents displayed weak decorporating effects. The most effective combinations for accelerating the urinary excretion of ^{131}I were potassium iodide-Lasix and potassium iodide-potassium perchlorate. (ERB)

11105 BEHAVIOR OF INHALED RADIOPROMETHIUM IN MICE AND THE EFFECT OF HEXAMETAPHOSPHATE ON THE EXCRETION OF THE NUCLIDE. Gensicke, F.; Hoelzer, F.; Nitschke, H. W. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Radiobiol.-Radiother.; 14: No. 2, 199-211(1973). (In German).

The decorporation, clearance and microdistribution of ^{147}Pm in mice after a single inhalation of $^{147}PmCl_3$ were studied. For the decorporation, hexametaphosphate (per inhalation and intraperitoneally, respectively) was used. The microdistribution was detected autoradiographically. After several treatments with hexametaphosphate from 24 hrs after the inhalation, the accumulation of the nuclide in the lung within 15 days can be decreased to 75%. The therapeutic effect also extends to the liver, the skeleton, and the whole body. In most cases, the clearance of ^{147}Pm has a multiphase course. The longest biological half-lives were calculated to be 74 days for the lung and 583 days for the whole body. The nuclide could be successfully eliminated from the organism by hexametaphosphate treatments at least after the inhalation of promethium chloride. Nevertheless microautoradiographic studies showed the activity concentrations in the intact macrophages of the lung to be hardly influenced by the treatment so that further therapeutic methods are to be looked for. (auth)

Plants

11106 (BNWL-1750(Pt.2), pp 2.1-2.2) INTERACTIONS OF PLUTONIUM AEROSOLS WITH PLANT FOLIAGE. Klepper, B.; Craig, D. K. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

Design of a facility for the exposure of plant foliage to Pu aerosols is described. Several species of agronomic importance will be studied for interactions between foliage and Pu particles. Preliminary studies include the exposure of two-week-old bean seedlings to ^{239}Pu nitrate aerosols of 1 to 3 μ size at wind speeds of 50 ft/min. (CH)

11107 (BNWL-1750(Pt.2), pp 2.4-2.7) BEHAVIOR OF WASTE RADIONUCLIDES IN SOIL-PLANT SYSTEMS. Price, K. R. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

Laboratory studies were conducted to determine the uptake by local Hanford plant species from local soils of neptunium, plutonium, americium and curium, and the uptake by local plants from local soils naturally contaminated with processing wastes or uptake from biological materials naturally contaminated with processing wastes. The relative uptake of four actinide elements from soil by two weedy plant species was studied under laboratory conditions. Solutions of $^{237}Np(NO_3)_5$, $^{239}Pu(NO_3)_4$, $^{241}Am(NO_3)_3$, and $^{244}Cm(NO_3)_3$ as well as acetate, oxalate, glycolate, and citrate complexes of each actinide were added to a sandy soil. Tumbleweed (Salsola kali) and cheatgrass (Bromus tectorum) plants were grown on the treated soil for two months in a controlled environment growth chamber. Shoot tissue was harvested, dried, and analyzed by liquid scintillation. The results are tabulated and discussed. (CH)

11108 (BNWL-1750(Pt.2), pp 2.7-2.8) DEVELOPMENT OF METHODS FOR MEASUREMENT OF PLUTONIUM COMPLEXATION IN SOIL AND UPTAKE BY PLANTS. Wildung, R. E.; Garland, T. R. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

The potential for entrance of plutonium into the food chain at the soil-plant level was assessed. Studies were undertaken to determine: the effects of plutonium on the soil microbial population and on soil microbial processes; the potential for formation of plutonium complexes in soil and the role of the soil microflora in this process; the extent of plant uptake and translocation of plutonium or its complexes; and the bond types and chemical forms of metabolites in microbial and plant tissues and soils. (CH)

New Tracer Techniques

Refer also to abstract 11076.

11109 (UCRL-74742) OZONE TAGGING FOR BIOMEDICAL PURPOSES. Meyer, P. (California Univ., Livermore. Lawrence Livermore Lab.). 4 May 1973. 4p. (CONF-730301-8). Dep. NTIS $3.00.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

The possibility of labeling ozone with ^{15}O, a positron emitter with a half life of 122 sec, was studied. With the use of the Anger positron camera, one can then in principle visualize the distribution of the radioactive ozone in the respiratory tract by observing the annihilation gamma rays from the decaying oxygen isotope. The procedure for labeling the gas is described. (ERB)

11110 ESTROGEN: TOPOGRAPHICAL LOCALIZATION OF ESTROGEN CONCENTRATING CELLS IN THE RAT SPINAL CORD FOLLOWING ^{3}H-ESTRADIOL ADMINISTRATION. Keefer, D. A.; Stumpf, W. E.; Sar, M. (Univ. of North Carolina, Chapel Hill). Proc. Soc. Exp. Biol. Med.; 143: No. 2, 414-417(Jun 1973).

After ^{3}H-estradiol injection, radioactivity was found to concentrate in certain cells in the rat spinal cord. The topography was determined by dry-mount autoradiography. The greatest density at all levels occurred in laminae I and II of the dorsal horn. In the lumbar cord, a second group of labeled cells appeared in the dorsal portion of lamina X. Occasional scattered labeled cells appeared throughout the remaining gray and white matter. It is suggested that the radioactivity-concentrating cells are estradiol target sites involved in sex-related sensation and reflexes. (auth)

11111 RAPID SCANNING OF ^{32}P-LABELED ACRYLAMIDE GELS. Brrtault, D. S.; Hayes, D. H. (Institut de Biologie Physico-Chimique, Paris). Anal. Biochem.; 53: No. 1, 272-277 (May 1973).

A simple and rapid procedure for scanning and quantitative evaluation of acrylamide gels containing ^{32}P-labeled material is described. It does not require any processing of the gel. (auth)

11112 NEW RADIOISOTOPIC MICROCYTOTOXICITY ASSAY OF CELLULAR IMMUNITY UTILIZING TECHNETIUM-99m. Barth, R. F.; Gillespie, G. Y. III; Gobuty, A. (Univ. of Kansas,

Kansas City). Nat. Cancer Inst. Monogr.; No. 35, 39-41(Dec 1972).

The development of immunity in mice to Sa-I tumors (fibrosarcoma) was assessed in vitro using ^{99m}Tc. A technique for microassay is described in which the nuclide is bound to cells by reductive treatment and does not appear to be reutilized following release. The data were compared with ^{3}H-TDR and ^{125}I-IUDR isotopic assays and with a microcytotoxicity assay based on the visual enumeration of surviving cells. (HLW)

11113 TISSUE CULTURE DETECTION OF CORRECTIVE FACTOR ACTIVITY FOR HURLER FIBROBLASTS. Herd, J. K. (St. Joseph Hospital, Omaha). Proc. Soc. Exp. Biol. Med.; 143: No. 2, 446-452(Jun 1973).

The isotope method of detection of corrective factor activity for cultured Hurler fibroblasts using radioactive sulfate ($^{35}SO_4$) has been confirmed and improved as a sensitive screening method. Its limitations were identified and discussed. Using this method it has been shown that cultured Hurler fibroblasts turn over 2-3 times less macromolecular $^{35}SO_4$-AMPS in 12-24 hr than do cultured normal fibroblasts. The results also establish the presence of a heat-labile corrective factor in fetal calf serum, which, because of its similar, though smaller effect on normal cells, is presumed to be nonspecific. (auth)

11114 USE OF IODINATED RNA FOR GENE LOCALIZATION. Prensky, W. (Tufts Univ., Boston); Steffensen, D. M.; Hughes, W. L. (Tufts Univ., Boston). Proc. Nat. Acad. Sci. U. S. A.; 70: No. 6, 1860-1864(Jun 1973).

Carrier-free iodination of 5S RNA with ^{125}I yields a probe suitable for use in cytological RNA-DNA hybridization studies. The genes coding for 5S ribosomal RNA in Drosophila could be localized by autoradiography after a 2-day exposure, whereas a 2-month exposure is needed when the best available [^{3}H]RNA is used. The procedure introduces one covalently bound ^{125}I atom per 100 nucleotides, resulting in a specific activity of over 10^{8} dpm/μg of RNA. The method may be readily applied to other problems involving molecular hybridization techniques. (auth)

11115 PREPARATION, PHYSIOLOGY, AND DOSIMETRY OF ^{111}In-LABELED RADIOPHARMACEUTICALS FOR CISTERNOGRAPHY. Goodwin, D. A.; Song, C. H.; Finston, R.; Matin, P. (Veterans Administration Hospital, Palo Alto, CA). Radiology; 108: No. 1, 91-98(Jul 1973).

The properties of ^{111}In-labeled transferrin, ^{111}In-EDTA, and ^{111}In-DTPA were studied in 37 patients undergoing cerebrospinal fluid scanning. The scan distribution of ^{111}In-transferrin (500 μCi) and ^{131}I-labeled RISA (200 μCi) was identical in six patients receiving simultaneous injections of the radiopharmaceuticals. Indium-111-EDTA and -DTPA also showed a scan distribution similar to RISA. Both the transferrin and chelate compounds of ^{111}In were satisfactory for cerebrospinal fluid studies. The count rate was highest with ^{111}In-transferrin due to rapid absorption of ^{111}In-DTPA and ^{111}In-EDTA and excretion in the urine. A comparison of useful photons per rad at 24 hrs postinjection showed ^{111}In superior to ^{131}I, ^{99m}Tc, ^{169}Yb, and ^{203}Pb. (auth)

11116 NONINVASIVE EVALUATION OF REGIONAL MYOCARDIAL PERFUSION WITH POTASSIUM-43. Strauss, H. W.; Zaret, B. L.; Martin, N. D.; Wells, H. P. Jr.; Flamm, M. D. Jr. (David Grant USAF Medical Center, Travis Air Force Base, CA). Radiology; 108: No. 1, 85-90(Jul 1973).

Six patients with angina pectoris received intravenous injections of potassium-43 both at rest and during exercise. Perfusion abnormalities were detected on the scans obtained during exercise that were not seen on the at-rest studies. Three normal patients were studied both at rest and during exercise, and all had normal scans on both occasions. Three patients with documented myocardial infarctions had abnormal scans when studied at rest. By combining the potassium-43 scan and exercise stress testing, the site and extent of transient myocardial ischemia can be evaluated. (auth)

11117 TRITIATION OF GLYCOPROTEINS. Gregoriadis, G.; Ryman, B. E. (Clinical Research Centre, Middlesex, Eng.). Biochem. Biophys. Res. Commun.; 52: No. 4, 1134-1140(19 Jun 1973).

Human ceruloplasmin and α_1-acid glycoprotein and bovine fetuin were tritiated by reductive methylation of the ϵ-amino group of lysine residues. Tritiated ceruloplasmin retained its oxidase activity and molecular sieve chromatography of the labeled glycoproteins showed that reductive methylation did not significantly affect their molecular size. In experiments with rats, tritiated glycoproteins exhibited plasma half-lives similar to those obtained with the same glycoproteins labeled by other methods. Further, reductive methylation did not alter the property shared by all three glycoproteins to promptly disappear from the circulation after their desialylation and injection into rats and to appear in the liver parenchymal cells. Labeling of glycoproteins by reductive methylation may be useful in metabolic studies requiring the use of both glycoproteins and their asialo-derivatives. (auth)

11118 ANALYSIS OF PRECURSOR POOL LABELING KINETICS WITHOUT POOL SIZE MEASUREMENTS: A COMPUTER-ASSISTED APPROACH. Cooper, H. L. (National Inst. of Dental Research, Bethesda, MD). Anal. Biochem.; 53: No. 1, 49-63 (May 1973).

A general method is described that permits the correction of macromolecular radioactive labeling data for precursor pool specific activity variation during a labeling period. Measurement of the precursor pool size is made unnecessary. The method involves: determination of radioactivity in the precursor pool at various times during an extended labeling period; derivation of a theoretical equation describing the kinetics of labeling of the precursor pool; computer-assisted fitting of the theoretical equation to the observed labeling data; and use of the parameters obtained from the curve-fitting to calculate the time course of saturation of the precursor pool with exogenous radioactive precursor. The derived saturation curves may be used to correct macromolecular labeling data, on a relative basis, for precursor pool saturation. The method may also be extended to provide absolute specific activity estimates. The application of the method is shown for the UTP and S-adenosyl methionine pools of cultured lymphocytes. (auth)

11119 MEMBRANE FILTER RETENTION: A SOURCE OF ERROR IN THE ^{14}C METHOD OF MEASURING PRIMARY PRODUCTION. McMahon, J. W. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Limnol. Oceanogr.; 18: No. 2, 319-324 (Mar 1973).

The relationship between volume of water filtered and apparent specific activity of phytoplankton in which the latter decreases (cpm ^{14}C ml^{-1}) with increasing volume filtered, previously attributed to cellular damage to phytoplankton during vacuum filtration, is now considered mainly due to retention of unfixed radiotracer on the membrane filter. The retention capacity for ^{14}C by the filter, expressed as radioactivity per milliliter filtered, is maximum for small sample volumes (≤1 ml), decreasing to a constant value when sample volumes are larger than 100 ml. This is attributed partially to absorption in the filter and probable retention of ^{14}C bound to unknown substances in the water or on the filter which are eluted or exchanged by passage of volumes of water of 100 ml or greater. This washing effect permits almost all of the ^{14}C not fixed in organisms to pass through the filter. (auth)

11120 EVALUATION OF LIQUID SCINTILLATION COUNTING TECHNIQUES FOR USE IN AQUATIC PRIMARY PRODUCTION STUDIES. Pugh, P. R. (Queen Elizabeth Coll., London). Limnol. Oceanogr.; 18: No. 2, 310-319(Mar 1973).

Methods evaluated for the liquid scintillation counting of samples from aquatic primary production studies include the counting of intact filters and cells in a toluene fluor, solubilization and counting of membrane filters and cells in various reagents, and counting of a suspension of cells mixed with the fluor. A 1:1 Triton X-100: toluene fluor was very effective for the suspension of cells and gave high counting efficiencies. Up to 5 ml of sample could be mixed with the fluor, but this was considered inadequate for most primary production studies. The filter standardization method for the counting of intact filters was investigated further and found to be applicable over a wide range of conditions but only accurate when the weight of algae on the filters was small (< 1 mg). Direct solubilization of the filters and cells in a naphthalene-dioxane or 2-methoxyethanoltoluene fluor were the simplest, most accurate, and economical methods for primary production studies; the latter dissolved both wet and dry cellulose nitrate membrane filters and gave excellent replicate counting. (auth)

11121 ASSAY OF CHORIONIC SOMATOMAMMOTROPIN HORMONE (OR PLACENTAL LACTOGEN) IN THE PLASMA OF PREGNANT WOMEN. Hubert, C.; Cedard, L. (Centre Hospitalier Universitaire, Paris). J. Biol. Med. Nucl.; 7: No. 29, 26-32(1972). (In French).

A technique is described for a radioimmunoassay that is simple and reproducible. It is based on the preferential adsorption of the free fraction on Fuller's earth. The technique is particularly applicable to diagnosing fetal hypotrophy in the case of delayed development in the uterus. (FR)

MATERIALS

11122 (COO-294-25) PARAMAGNETIC RESONANCE ABSORPTION. Final Report. Hutchison, C. A. Jr. (Chicago Univ., Ill.). 4 May 1973. Contract AT(11-1)-294. 21p. Dep. NTIS $3.25.

Research in the following areas is briefly summarized: f-electron molecules and ions (including transition element ions), and organic molecules in triplet electronic states. (61 references) (DLC)

11123 PERSPECTIVES IN MOESSBAUER SPECTROSCOPY. Proceedings of the International Conference Held at Ayeleth Hashahar, Israel, August 28-31, 1972. Cohen, S. G.; Pasternak, M. New York; Plenum Publishing Corporation (1973). 265p. (CONF-720834-). $15.00.

From international conference on applications of the Mössbauer effect; Galilee, Israel (27 Aug 1972).

Sixteen papers are presented in the following areas: magnetic properties of solids, applications to inorganic chemistry, biochemical studies, amorphous systems, metal alloys, advances in high-resolution studies, and new techniques for studying recoil-free spectra. The paper on high-resolution Moessbauer spectroscopy with ^{181}Ta was previously abstracted in NSA. (DLC)

Ceramics and Cermets

Refer also to abstracts 10771, 11214, 11230, 11231, 11234, 11260, 11294, 11296, 11319, 11322–11324, 11328, 11336, 11337, 11347, and 12062.

11124 (AAEC/E-245) PILOT-PLANT DEVELOPMENT OF PROCESSES FOR THE PRODUCTION OF NUCLEAR-GRADE URANIUM DIOXIDE. Alfredson, P. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1972. 33p. Dep. NTIS (U.S. Sales Only) $3.75.

Most types of power reactors use fuel in the form of high-density uranium dioxide pellets clad in Zircaloy. Sinterable uranium dioxide powder is usually produced via the ammonium diuranate (ADU) route. This involves dissolution of uranium ore concentrates (yellow cake) in nitric acid, purification by solvent extraction using tributyl phosphate in kerosene, precipitation of ADU, filtration, drying, calcination and reduction with hydrogen to give uranium dioxide powder. Pilot plant development of these processes has been carried out to demonstrate the production of nuclear-grade uranium dioxide from Australian yellow cake and to improve the processes and technology wherever possible. This paper describes the processes and equipment with particular reference to the improvements which have been made. The nitric acid requirements in the solvent extraction process have been substantially reduced and a pulsed fluidized bed reactor has been developed for the continuous calcination–reduction of ADU to uranium dioxide. The influence of the conditions for precipitation of ADU on its rate of filtration and on the fabrication behaviour of the uranium dioxide powder is also described. (10 figures, 4 tables, 21 references) (auth)

11125 (AECL-4427, pp 9-11) ESTABLISHMENT OF A URANIUM CARBIDE FUEL PRODUCTION CAPABILITY IN CANADIAN INDUSTRY. Lane, A. D.; Lee, H. R. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Win 1972.

Uranium carbide is the reference fuel for Canada's organic-cooled reactor program. A pilot production facility is being established at Eldorado Nuclear Limited to produce finished stacks of UC. The facility will demonstrate the process line, generate production costs, evaluate process refinements, and supply fuel for the WR-1 experimental reactor. (auth)

11126 (ANL-Trans-942) CREEP BEHAVIOR OF OXIDE FUELS UNDER NEUTRON IRRADIATION. Bruecklacher, D.; Dienst, W.; Thummler, F. Translated by J. L. Routbort (Argonne National Lab., Ill.) from Paper No. 251 of Reactor Meeting, Deutsches Atomforum, Karlsruhe, Germany, April 10–13, 1973. 9p. Dep. NTIS $3.00.

The dependence of creep in sintered PuO_2–UO_2 disks on temperature and burnup was examined. It was found that the measured creep rate in these disks has the same temperature dependence as UO_2 below 700°C. In the temperature range 900 to 1000°C the creep rates are lower than those found below 700°C. This rate appears to be controlled by density and homogeneity of Pu distribution at high temperatures. (JRD)

11127 (BARC-646) SINTERING OF BERYLLIUM OXIDE: INFLUENCE OF MINOR ADDITIONS ON DENSIFICATION AND MICROSTRUCTURAL DEVELOPMENT. Bhat, R.; Moorthy, V. K. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 19p. Dep. NTIS (U.S. Sales Only) $3.00.

The influence of 0.01 to 5 wt. % additions of minor constituents such as MgO, TiO_2, and Fe_2O_3 on the sintering behaviour and grain development of beryllium oxide was studied at temperatures between 1100 and 1500°C in vacuum and in air. Both densification and grain growth attained a maxima with MgO and TiO_2 additions, the optimum value being around 1%. With Fe_2O_3, both the densification and grain growth seem to be directly related to the amount of addition. (auth)

11128 (EURFNR-1091) AFTERSINTERING BEHAVIOR OF UO_2/PuO_2 FUEL PELLETS. Dippel, T.; Guenther, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Mar 1973. 22p. (KFK-1781). Dep. NTIS $3.25.

Work performed under United States–Euratom Fast Reactor Exchange Program.

By calcination of UO_2–PuO_2 powder mixtures it is possible to fabricate fuel pellets with densities between 85 and 90% T.D. On repeating the sintering process shrinkage of pellets will proceed, but related to the density of sintered pellets and the calcination temperature of the powder mixtures this additional shrinkage of the sintered pellets will be different. By proper choice of the calcination temperature the increase in pellet density can be kept within the predetermined limits. (auth)

11129 (GERHTR-72) DEVELOPMENT OF COATED FUEL PARTICLES FOR INCREASED SAFETY REQUIREMENTS. Foerthmann, R.; Gyarmati, E.; Hilpert, K.; Nickel, H. (Kernforschungsanlage, Juelich (West Germany)). 9 Feb 1973. 25p. Dep. NTIS (U.S. Sales Only) $3.25.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

The ceramic nuclear fuel of high-temperature gas-cooled reactors (HTGR) is compacted into graphite fuel elements in the form of coated particles consisting of small spherical fuel kernels and several different layers of pyrocarbon for fission-product retention. The average fission-gas release is about $R/B = 10^{-5}$, but some of the solid fission products are released in larger amounts up to $R/B = 10^{-2}$. For special types of HTGR's the development of coated fuel particles for increased safety requirements was started. The aim of this program is a better retention of the solid fission products in coated particles. The well-known decrease of Sr release by silicon carbide interlayers was found to be a function of the SiC structure and density. Therefore the correlation between the coating conditions during the deposition of SiC and its properties are studied in detail. In addition to this work, new kernel materials have been developed that retain solid fission products in the fuel kernel by solid-state chemical reactions with special refractory oxides added to the kernel material. Part of the Al_2O_3 in the fuel kernel reacts with Sr and Ba forming the compounds $SrAl_2O_4$ and $BaAl_2O_4$ thus reducing the release of these fission products from the kernel by a factor up to 100. The same effect is found for the fission-product cesium if a mixture of Al_2O_3 and SiO_2 is added to the kernel material forming the refractory compound $CsAlSi_2O_6$. In the case of barium the mechanism of kernel retention was studied in more detail by measurements of vapor pressure and by irradiation experiments for investigating the influence of fast neutrons on the solid fission-product transport behavior in coated particles. (auth)

11130 (JINR-E4-7030) METAL–INSULATOR TRANSITION IN A TWO-BAND HUBBARD-MODEL WITH APPLICATION TO VO. Elk, K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 35p. Dep. NTIS (U.S. Sales Only) $3.75.

A model is considered containing two hybridized narrow electron bands. It is shown, that in such a model a metal–insulator transition occurs, connected with a jump of the conductivity. Some analogies to the Lifshitz instabilities are discussed. As a possible example for such a behavior, the properties of VO are studied qualitatively and quantitatively. (tr-auth)

11131 (KFK-1781) POST-SINTERING QUALITY OF UO_2–PuO_2 FUEL PELLETS. Dippel, Th.; Guenther, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Mar 1973. 19p. (In German). Dep. NTIS (U.S. Sales Only) $3.00.

By calcination of UO_2–PuO_2 powder mixtures it is possible to fabricate fuel pellets with densities between 85 and 90% T.D. On repeating the sintering process, shrinkage of pellets will proceed,

but depending on the density of the sintered pellets and the calcination temperature of the powder mixtures, this additional shrinkage of the sintered pellets will be different. By proper choice of the calcination temperature the increase in pellet density can be kept within the predetermined limits. (GE)

11132 (LA-5173) PARTICULATE COMPOSITE MATERIALS TECHNOLOGY. Riley, R. E.; Taub, J. M. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 9p. Dep. NTIS $4.00.

Data are presented on various composite materials studied at LASL. The materials include W–Ni–Fe alloys without and with Re (mechanical properties and microstructure); ZrO_2–ZrC, UO_2–ZrC, UO_2–HfC, and HfO_2–HfC composites (thermal conductivity); TaC–NbC–C composites (flexure strength and thermal shock rating); and Cu–B_4C sheet (relative neutron absorber effectiveness). (DLC)

11133 (LA-5284-PR) ADVANCED PLUTONIUM FUELS PROGRAM. Quarterly Report, January 1–March 31, 1973. Baker, R. D. (comp.). (Sandia Labs., Albuquerque, N. Mex.). May 1973. Contract W-7405-eng-36. 29p. Dep. NTIS $4.00.

Progress is reported in the examination of fast reactor fuels (equipment, analytical chemistry, operations, quality control), high-performance LMFBR fuel materials (irradiation testing, analysis of Ta in stainless steel, coulometric titration of Pu and U, quality assurance), and analytical standards for fast breeder reactor oxide fuel (boron carbide and mixed oxide fuel). (DLC)

11134 (MLM-2006) X-RAY DIFFRACTION TIME-STUDIES OF PLUTONIA AND THORIA SOLID SOLUTIONS. Seabaugh, P. W.; Eckstein, R. R.; Warner, D. K. (Mound Lab., Miamisburg, Ohio). 5 Jun 1973. Contract AT-33-1-GEN-53. 16p. Dep. NTIS $4.00.

Studies of variations of the lattice parameters of several $^{238}PuO_2$–ThO_2 solid solution samples, as a function of time, were undertaken to describe the aging process as a function of the expansion of the plutonia lattice. The studies suggest that x-ray diffraction can be a simple and practical method for the determination of thorium : plutonium composition ratios of $^{238}PuO_2$–ThO_2 solid solutions. They also confirm that an exponential growth equation adequately describes the change of the lattice parameter (a), with time, of the PuO_2–ThO_2 solid solutions and that a $^{238}PuO_2$–ThO_2 solid solution sample can be reannealed to obtain a correct value for a_0. A nonlinear least squares procedure was used to determine the constants α, a_0, and C. The solid solutions were found to retain their crystallinity over an extended time period. (auth)

11135 (NAA-SR-5413) COMPATIBILITY OF SNAP FUEL AND CLAD MATERIALS. Balkwill, J. K. (Atomics International, Canoga Park, Calif.). 15 Oct 1960. Contract AT(11-1)-GEN-8. 31p. Dep. NTIS $3.75.

Declassified 3 May 1973.

Sample capsules containing buttons of materials of interest for SNAP fuel elements were held at temperatures up to 1600°F, in hydrogen, under a 20-tsi load for 200+ hours. The hydrided Zr–U alloys formed significant diffusion zones at 1200°F with Hastelloy-B, Inconel-X, Type 347 stainless steel, gold, and copper; but did not alloy with molybdenum, beryllium, or nickel at this temperature. At 1600°F, diffusion was also found between the fuel and molybdenum and nickel. The fuel did not react with the Type S-1435A Solaramic cladding coating at test temperatures of 1200 and 1500°F. At 1300°F, beryllium formed a diffusion zone with both Hastelloy-B and Inconel-X, and also reacted with the Solaramic, while BeO did not react with any of these. (auth)

11136 (NAA-SR-10516) DIFFUSION COEFFICIENT OF HYDROGEN IN DELTA-PHASE ZIRCONIUM HYDRIDE. Harkness, S. D.; Young, W. A. (Atomics International, Canoga Park, Calif.). 22 Feb 1965. Contract AT(11-1)-GEN-8. 18p. Dep. NTIS $3.00.

Declassified 17 Apr 1973.

Diffusion coefficients of hydrogen in δ-phase SNAP fuel were determined from experimental hydrogen sorption curves for H/Zr atom ratios of 1.50 to 1.80 and for the temperature range of 650 to 900°C. The values fit the expression: $D = (1.3^{+1.1}_{-1.0}) \times 10^{-2} \exp - (12690 \pm 3444/RT)$. The results are compared with those in the literature for diffusion of hydrogen in zirconium and titanium hydrides. An analysis of the experimental errors indicates an uncertainty of ±25%. No concentration dependence was observed for the diffusion coefficients. Tests using pure zirconium hydride and unmodified fuel indicate that neither carbon nor uranium have any effect on the diffusion of hydrogen in δ-phase fuel. (auth)

11137 (NAA-SR-10851) IRRADIATION STABILITY OF AI 8763D HYDROGEN BARRIER MATERIAL. Engberg, C. J. (Atomics International, Canoga Park, Calif.). 15 Apr 1965. Contract AT(11-1)-GEN-8. 44p. Dep. NTIS $4.25.

Declassified Oct 1972.

The NAA 68-1 irradiation experiment was designed to determine the effect of neutron irradiation on the hydrogen barrier material used in the S8ER fuel elements. The capsule was irradiated in ETR Core Position E5-SE from March 15 to September 16, 1963, and received a peak integrated neutron dosage of 1.03×10^{21} nvt ($E_n > 1$ MeV) in 2337 h. The irradiation temperature range was 750 to 1200°F for the upper specimen, and 1105 to 1250°F for the lower specimen. Pre- and postirradiation hydrogen permeation rates are compared, and the structural changes observed in the Hastelloy N cladding material are discussed. (auth)

11138 (NAA-SR-Memo-8348) POST-IRRADIATION ANNEALING STUDIES ON LIGHTLY IRRADIATED Zr–U–H FUEL SYSTEMS. Willis, A. H.; Moses, A. J. (Atomics International, Canoga Park, Calif.). 21 Mar 1963. Contract AT(11-1)-GEN-8. 25p. Dep. NTIS $3.25.

Declassified 3 May 1973.

Samples of ZrH–UH fuels taken from acceptable regions of two SNAP-8 fuel rods that had been rejected because of localized surface cracking were irradiated in the shield test reactor to parts-per-million of fuel burnup and then annealed to evaluate fission gas mobility. Modified and unmodified fuel samples were tested. Test results show that there were differences between the tested modified and unmodified materials and differences between samples taken from the same rod. The occurrence of the $\delta-\beta$ transformation causes bursts of released gas. No similar response is noted for the $\epsilon-\delta$ transformation. A single transformation does not cause 100% gas release and successive transformations cause additional release of fission gases. The fission gas mobility is unrelated to hydrogen mobility unless hydrogen loss causes a phase transformation. (JRD)

11139 (ORNL-TM-4055) FUELS AND MATERIALS DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 30, 1972. Patriarca, P. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 217p. AT $7.60.

Research and development progress is summarized in 5 sections. A separate abstract was prepared for each section. (JRD)

For abstracts of individual sections see: 11140, 11218, 11219, 11241, and 11325.

11140 (ORNL-TM-4055, pp 1.1-1.34) DEVELOPMENT OF FBR NEUTRON-ABSORBER MATERIALS. Jan 1973.

In fuels and materials development program quarterly progress report.

Progress is reported on: (1) determining the irradiation performance of boron carbide and europium oxide for application to the FTR and to determine how material and operating variations affect this performance; (2) evaluating the irradiation behavior of tantalum and tantalum alloys as potential control materials for demonstration LMFBRs; and (3) developing vent materials so that helium generated during irradiation of boron carbide may be safely and reliably released to the coolant. (auth)

11141 (ORO-3291-17) APPLICATION OF ADIABATIC CALORIMETRY TO METAL SYSTEMS. Progress Report, 1972–1973. Brooks, C. R.; Stansbury, E. E. (Tennessee Univ., Knoxville. Dept. of Chemical and Metallurgical Engineering). 1973. Contract AT(40-1)-3291. 11p. Dep. NTIS $3.00.

Research on the heat capacity of liquid metals and stainless steel is summarized. Data and discussions are included on Bi heat capacity, and heat capacity of austenitic stainless steels. (JRD)

11142 (PNCT–831-72-3) TOKAI WORKS SEMIANNUAL PROGRESS REPORT, JANUARY–JUNE 1972. (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Dec 1972. 128p. Dep. NTIS (U. S. Sales Only) $8.50.

Activities devoted to development and fabrication of Pu-bearing fuels, research on centrifugal U enrichment technology, and construction of a fuel processing plant are summarized. (JRD)

11143 (UCRL-51375) THERMAL ANNEALING OF IRRADIATED LiH. Leider, H. R.; Teas, V.; Griffith, C. M. (California Univ., Livermore. Lawrence Livermore Lab.). 12 Apr 1973. Contract W-7405-eng-48. 21p. Dep. NTIS $4.00.

The effects of thermal annealing of irradiated LiH on density, bubble size, and bubble size distribution are presented for materials subjected to a wide range of irradiation conditions. (auth)

11144 (Y-1191) LITHIUM HYDRIDE AS A MOBILE NEUTRON SHIELD. Waldrop, F. B. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 24 Feb 1958. Contract W-7405-eng-26. 19p. (CONF-580101-1). Dep. NTIS $3.00.

Declassified 16 Mar 1973.

The advantages and disadvantages of utilizing lithium hydride for shielding purposes are discussed. Fabrication methods and physical properties are described. (auth)

11145 WETTING OF CARBON AND CARBIDES BY COPPER ALLOYS. Mortimer, D. A.; Nicholas, M. (Atomic Energy Research Establishment, Harwell, Eng.). J. Mater. Sci.; 8: No. 5, 640-648(May 1973).

In a previous paper (Mortimer, J. Mater. Sci., 5: 149(1970)) a model was developed to predict the wetting behavior between carbon and copper alloys containing 1 at. % of a carbide-forming element. It is shown that the model can be applied successfully to alloys containing as little as 0.15 at. % chromium or vanadium and as much as 13 at. % titanium. Included in the study were Cr_2C_2, HfC, NbC, TiC, UC, VC, WC, ZrC. A further development of the model is its use to predict carbide surface energies, the values derived being in good agreement with literature data. (auth)

11146 CONDITIONS FOR FORMATION OF ErB_6. Mar, R. W. (Sandia Labs., Livermore, CA). J. Amer. Ceram. Soc.; 56: No. 5, 275-278(May 1973).

Erbium hexaboride was synthesized; it is a high-temperature phase, stable over a limited temperature range, and unstable with respect to dissociation to ErB_4 and ErB_{12} at $T < 1975°C$, although the lower temperature limit has not been determined precisely. Relatively slow cooling through its stable temperature range is required for the formation of ErB_6. (auth)

11147 ACOUSTIC FATIGUE IN CERTAIN CERAMIC MATERIALS. Seaton, C. C.; Katz, R. N. (Army Materials and Mechanics Research Center, Watertown, MA). J. Amer. Ceram. Soc.; 56: No. 5, 283(May 1973).

Ceramic materials were evaluated for applications in which sonic vibrations are part of the environment such as for use in gas turbine engines. Results are given that determined the existence of acoustic fatigue and ascertained its effects on damaged microstructures. Acoustic fatigue of thermally shocked samples was also determined. All specimens were resonated for 10 min in the flexural mode of vibration. Titanium diboride was most affected by sonic vibration. Crack-free Al_2O_3 appears to be subject to acoustic fatigue. Si_3N_4 was not susceptible to degradation of strength during sonic vibration. Results indicate that ceramic materials may or may not be subject to acoustic fatigue when vibrated at their resonant frequencies in the kilocycle range. The extent of strength degradation is a function of the properties of the material as well as the structural integrity of the ceramic. (JCW)

11148 MISCIBILITY GAP IN THE SYSTEM $PbO-B_2O_3$. Simmons, J. H. (Inst. of Materials Research, Washington, DC). J. Amer. Ceram. Soc.; 56: No. 5, 284-285(May 1973).

The lead borate system shows an extensive miscibility gap on the borate-rich side of the phase diagram. The immiscibility measurements reported were conducted at high temperatures in a horizontal furnace. Operator variations were $< \pm 1°C$ in most cases. Uncertainty arising from diffusion generally varied from zero to 3.9°C, although 3 samples exhibited a greater difference (8, 9, and 15°C). Bulk samples were analyzed for PbO content by conventional wet chemical methods. Crystallization was observed at 17.7, 18.0, 19.0, and 20% PbO. The liquidus temperature at 17.7% PbO was measured at 752°C, and the liquid-liquid phase separation between 701 and 709°C occurs in a metastable region with respect to crystallization. Results and observations are compared with previous experiments. (JCW)

11149 $CeO_2-Y_2O_3$ SOLID SOLUTIONS. Anderson, H. T.; Wuensch, B. J. (Massachusetts Inst. of Tech., Cambridge). Contract AT(11-1)-3344. J. Amer. Ceram. Soc.; 56: No. 5, 285-286(May 1973).

Preparation of $CeO_2-Y_2O_3$ solid solutions was attempted at 800°C (where at least the M_7O_{12} iota phase is stable in pure lanthanide oxides) using freeze-drying, but the preparation of freeze-dried $CeO_2-YO_{1.5}$ was unsuccessful. Attempts were made to achieve equilibrium structures through conventional techniques by prolonged annealing. Two methods are described. The samples were examined by x-ray diffraction. Results are compared with many other experimental results, and it may be that either the disordered equilibrium structure of 1100 to 1700°C persists at 800°C or that the equilibrium structure at 800°C was not obtained and the structural state corresponds to that at 1750°C. Results suggest that equilibrium structures were not obtained. It is concluded that conventional processing cannot produce equilibrium structures in such systems. (JCW)

11150 SURFACE-DIFFUSION THEORY FOR DRYING CREEP EFFECT IN PORTLAND CEMENT PASTE AND CONCRETE. Bazant, Z. P.; Moschovidis, Z. (Northwestern Univ., Evanston, IL). J. Amer. Ceram. Soc.; 56: No. 5, 235-241(May 1973).

An attempt is made to introduce quantitative analysis into the complex problems of the mechanism of drying creep in cement paste. The main source of creep is assumed to be the change in thickness of hindered adsorbed water layers caused by diffusion of water, coupled with diffusion of solids dissolved from the confining adsorbent particles. The basic equations of equilibrium and irreversible thermodynamics governing the problem are formulated, reduced to an initial-boundary value problem, and solved numerically. Computer studies have indicated that the drying creep effect is very likely caused by nonlinear coupling between the diffusion of water and that of solids in the hindered adsorbed layers. (auth)

11151 ZASHCHITNYE VYSOKOTEMPERATURNYE POKRYTIYA. Trudy 5-go Vsesoyuznogo Soveshchaniya po Zharostoikim Pokrytiyam, Khar'kov, 12-16 Maya 1970 g. (Protective High-Temperature Coatings. Transactions of the Fifth All-Union Conference on Heat-Stable Coatings, Khar'kov, USSR, May 12-16, 1970). Ivanov, V. E. (ed.). Leningrad; Izdatel'stvo Nauka Leningradskoe Otdelenie (1972). 368p. (CONF-700477-).

From 5th all-union conference on heat-stable coatings; Khar'kov, USSR (12 May 1970).

A collection of 49 papers on various aspects of the production and properties of heat-resistant coatings is presented. A few of the specific materials described are: TiC, TiC-Nb, TiC-Ta, TiN-V, TiV-Zr, and the systems Mo-Al and W-Al. Physico-chemical properties are given in detail for ZrO_2, BeO, TiB_2, CrB_2, ZrB_2, NbB2, Mo_2B_5, HfB_2 and TaB_2. Glass-ceramic coatings, metalloceramic coatings, and silicides of Mo, W, Ti are discussed in a number of papers. Methods employed in producing various coatings include electrochemical, plasma, detonation, sputtering, precipitation from solutions or the gas phase, molten salts, and the decomposition of carbonyls. (KSW)

11152 ROOM-TEMPERATURE CREEP OF BORSIC-ALUMINUM COMPOSITES. Ericksen, R. H. (Sandia Labs., Albuquerque, NM). Met. Trans. 4: No. 7, 1687-1693(Jul 1973).

Creep of aluminum reinforced with continuous Borsic filaments was investigated at 27°C. Composites having filaments oriented 0, 0 ± 45, 0 ± 60, 0 ± 90, ± 45, and 90° with respect to the tensile axis were tested for times up to 1000 h. Creep tests were also performed on unreinforced aluminum and on the Borsic filaments. Creep in the Borsic filaments and in composites having filaments parallel to the direction of loading followed a logarithmic time law. The unreinforced aluminum matrix crept following a logarithmic time law only at low stresses and for relatively short times. Composite creep was compared with that in the matrix and filaments by taking into account the effect of load transfer due to relaxation of the matrix. Time dependent failure of composites having some filaments parallel to the load direction was observed only at creep stresses near the tensile fracture stress. The ±45 and 90° composites exhibited deviations from logarithmic creep behavior similar to that of the unreinforced matrix. However, the presence of the filaments influenced the magnitude of the load-on strain and the creep rate, particularly in the 90° orientation. (9 figures, 31 references) (auth)

11153 PECULIARITIES OF HIGH-TEMPERATURE OXIDATION OF GROUP VI TRANSITION METAL CARBIDES. Voitovich, R. F.; Pugach, E. A. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 4, 59-64(Apr 1973). (In Russian).

High-temperature oxidation of Cr_3C_2, Mo_2C, and WC was investigated in the air for 5 hr within a temperature range of 500 to 1200° C. Thermodynamic possibility of the reaction proceeding in the systems carbide-oxygen (nitrogen) is discussed to interpret the data obtained. To detect a possible mechanism of oxidation, kinetic, x-ray metallographic, and microhardness methods were used. (auth)

11154 CORROSION-ELECTROCHEMICAL BEHAVIOR OF $Me_{23}C_6$ CARBIDES IN SULPHURIC ACID. Suprunov, V. A.; Freid, M. Kh.; Levin, I. A. (Ivanovo Chemical-Technological Inst., USSR). Porosh. Met., Akad. Nauk Ukr. SSR; No. 4, 50-54 (Apr 1973). (In Russian).

Corrosion-electrochemical behaviour of synthesized simple carbides $CR_{23}C_6$ and those alloyed with iron, nickel, and molybdenum was studied in H_2SO_4 solutions (0.01 to 3N) at temperatures of 25, 50, and 85°C. On the basis of analysis of the anode potentiostatic curves, a diagram is plotted showing the effect of alloying elements on the position of critical points S_π, $S_{\pi\pi}$, and $S_{\pi ep}$. (π = passivation, $\pi\pi$ = complete passivation, πep = superpassivation). A dependence is established of carbide corrosion resistance on the degree of alloying with Fe, Ni, and Mo, on tem-

perature and acid concentration. Extragive character of iron–chromium carbide dissolution is found. (auth)

11155 HARD ALLOYS WC–Co AS DISPERSE-STRENGTHENED MATERIALS. II. Stress-Strain Curves. Strength Limitation. Kreimer, G. S.; Tumanov, V. I. Porosh. Met., Akad. Nauk Ukr. SSR; No. 4, 44-49(Apr 1973). (In Russian).

Shape and character of the stress–strain curves for WC–Co alloys in the region of small plastic strains are shown to coincide with those of similar curves for dispersion-strengthened alloys with incoherent and undeformed particles of the solid phase. Dependence of strengthening on composition of the WC–Co alloys is in complete agreement with the theory of Fisher et al., for dispersion-strengthened alloys. (auth)

11156 CREEP DURING HOT PRESSING OF TITANIUM NITRIDE, MOLYBDENUM DISILICIDE: ZIRCONIUM AND CHROMIUM DIBORIDES' POWDERS. Koval'chenko, M. S. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 4, 7-13(Apr 1973). (In Russian).

The dependence of relative density of TiN, $SoSi_2$, ZrB_2, and CrB_2 on time, temperature, and applied pressure are analyzed by using the equation of porous body compaction including steady-state creep. The equation is shown to describe the compaction kinetics of refractory compound powders during hot pressing. $MoSi_2$ powder compaction at hot pressing is realized due to α-creeping at temperatures of 1600°C and lower; at high temperatures after a short (~3 min) stage of transient creep, steady-state creep takes place. Activation energies of steady-state creep of the compounds at sintering temperatures and the effective Laplace pressure values are estimated. The values of the creep activation energy correspond to those for self-diffusion of atoms in metal sublattices of the compounds. (3 tables, 10 figures) (auth)

11157 THERMODYNAMIC CALCULATION OF EQUILIBRIUM COMPOSITIONS OF THE SYSTEM CARBIDE-HYDROGEN-OXYGEN. Gorchunov, O. L.; Tsukhanova, O. A.; Knyazheskaya, M. V. (Inst. of High Temperatures, Moscow). Porosh. Met., Akad. Nauk Ukr. SSR; No. 4, 65-69(Apr 1973). (In Russian).

Thermodynamic composition of products of the heterogeneous system carbide–hydrogen–oxygen is calculated for a temperature range of 1500 to 3100°K at a pressure of 1 to 20 atm and values of carbon activity in carbide 0.5, 0.1, 0.01, and 0.001. Oxygen content varied from 0.01 to 1%. It is shown that hydrocarbon component composition for the above-mentioned conditions does not depend practically on oxygen content in the system (to 1 rel.%). (auth)

11158 ESTABLISHMENT OF THE EXISTENCE OF TWO NEW PHASES IN THE Ba_3UO_6–Er_2O_3 SYSTEM. Philibert, B.; Poix, P. (Paris Univ., Orsay, France). Compt. Rend., Ser. C; 276: No. 7, 595-598(12 Feb 1973). (In French).

Studies of the Ba_3UO_6–Er_2O_3 system revealed the existence of two new phases: a cubic phase (x = 0.05) having a parameter a = 8.879 Å; an orthorhombic phase (x = 0.92) having parameters a = 6.153 Å, b = 6.119 Å, c = 8.632 Å. It was not possible to synthesize the $Ba_3UEr_2O_9$ compound. (FR)

11159 LOW-OHMIC CARBIDE RESISTORS. Grebenkina, V. G.; Yusov, Yu. P.; Sorokin, V. N.; Perevezentsev, A. V. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 4, 97-100(Apr 1973). (In Russian).

Temperature dependence of electric resistance, thermal expansion coefficient, and resistance to oxidation was investigated in NbC, Cr_3C_2, and alloys of the system TaC–WC. It was found that within a temperatures range from room up to 1000°C the alloys Cr_3C_2 and $Ta_{0.4}W_{0.6}C$ possess a comparatively low temperature coefficient of resistance (TCR). To extend the scale of rated values for resistances into the low-ohmic domain as well as to increase moisture resistance and decrease of TCR, a composition is suggested containing 37% by volume of $Ta_{0.4}W_{0.6}C$ as a current-conducting phase of the resistor, the rest (to 100%)–glass binder and filler. The investigations carried out in the resistors within the size of articles TBO-0.5 and TBO-0.25 showed that the alloys $Ta_{0.4}W_{0.6}C$ is resistive. (auth)

11160 WESTEC 1972 CONFERENCE ABSTRACTS, FEATURING THE THIRD AIR FORCE METALWORKING CONFERENCE HELD AT LOS ANGELES, CALIFORNIA, MARCH 13–17, 1972. Metals Park, OH; American Society for Metals (1972). 105p. (CONF-720346-(Absts.)). $5.00.

From ASM and SME western metal and tool exposition and conference; Los Angeles, California, USA (13 Mar 1972).

Approximately 270 abstracts are presented on preparation, properties, fabrication, and testing of metals, ceramics, and refractories. (JRD)

11161 SINTERING AND RELATED PHENOMENA. PROCEEDINGS OF THE THIRD INTERNATIONAL CONFERENCE HELD AT NOTRE DAME, INDIANA, JUNE 5–7, 1972. Kuczynski, G. C. (ed.). Materials Science Research, Volume 6. New York; Plenum Publishing Corporation (1973). 461p. (CONF-720647-). $25.00.

From 3rd international conference on sintering and related phenomena; Notre Dame, Indiana, USA (5 Jun 1972).

Abstracts were prepared for five papers from a total of thirty-eight. The papers were grouped according to: Point Defects and Transport Phenomena; Grain Growth and Ostwald Ripening; Sintering (general, nonisothermal, fine particle, and application of models); Hot Pressing; and Applications. (JCW)

For abstracts of individual papers see: 11162–11164, 11267, and 11268.

11162 SINTERING KINETICS OF α-Nb_2O_5 IN NONISOTHERMAL CONDITIONS. Uskokovic, D.; Ristic, M. M. (Boris Kidrich Inst. of Nuclear Science, Belgrade). pp 283-292 of Sintering and Related Phenomena. Kuczynski, G. C. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on sintering and related phenomena; Notre Dame, Indiana, USA (5 Jun 1972). See CONF-720647-.

It was found that the rate change of the relative linear shrinkage follows the law of the distribution function close to the normal distribution. The maximum in the curve of the distribution n = f(T,r) is the result of the change of the material structure state only, due to the change of the powder activity. The point defect concentration is the function of the oxygen partial pressure and the temperature. The abrupt increase of the relative linear shrinkage cannot only be the result of the existence of the point defects; it is obvious that the other structure defects must also affect this phenomenon. The sintering character of the examined α-Nb_2O_5 (low shrinkage up to high temperatures) is evident proof of the existence of the high-temperature defects whose origin and character have not been defined in a uniform way. The qualitative analysis of the sintering process from the aspect of the atomic theory of the electronic configuration indicates that the high temperature of the intensive sintering of α-Nb_2O_5 is the result of the high degree of localization of d^5 niobium atoms. (auth)

11163 SINTERING AND DESINTERING OF THORIA. Morgan, C. S. (Oak Ridge National Lab., TN); McCorkle, K. H.; Powell, G. L. pp 293-299 of Sintering and Related Phenomena. Kuczynski, G. C. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on sintering and related phenomena; Notre Dame, Indiana, USA (5 Jun 1972). See CONF-720647-.

The processes of sintering and desintering (loss of bulk density) in thoria are examined. The mechanisms of material transport and driving forces for both processes are considered. Desintering of ThO_2 can cause a density decrease of as much as 10% and may contribute to the frequently observed failure of sintering compacts to reach theoretical density. Under the conditions studied, desintering does not appear to be a gas-pressure effect. Desintering is greatest in ThO_2 specimens achieving a high density while retaining a small grain size. (auth)

11164 MECHANISMS OF SINTERING DURING HOT PRESSING AND RECENT TECHNOLOGICAL ADVANCES. Spriggs, R. M. (Lehigh Univ., Bethlehem, PA); Dutta, S. K. pp 369-394 of Sintering and Related Phenomena. Kuczynski, G. C. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on sintering and related phenomena; Notre Dame, Indiana, USA (5 Jun 1972). See CONF-720647-.

Advances made in an understanding of the mechanisms of sintering during hot pressing are outlined. These include not only very recent diffusion models for the intermediate and final stages of sintering, but also the combined concurrent effects of particle rearrangement, plastic flow, and diffusion. Multicomponent mechanisms, either constraining or enhancing Newtonian diffusional mechanisms, are also described. By analogy with recent steady-state creep studies, the possible role of diffusion-controlled grain-boundary sliding is also suggested. Achievements in microstructural uniformity, the fabrication of large, multiple curvature shapes, considerable reduction in cost, and the development of a host of non-oxide ceramics for high-performance applications are gained. 65 references. (auth)

11165 ADVANCED MATERIALS: COMPOSITES AND CARBON. 73rd Annual Meeting of the American Ceramic Society, Chicago, Illinois, April 26–28, 1971. Buckley, J. D. (comp.). Columbus, OH; American Ceramic Society Inc. (1972). 232p. (CONF-710466-). $13.00.

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971).

Twenty-four papers were presented at the symposium. A separate abstract was prepared for each of sixteen papers. One

paper was previously abstracted in NSA as 26: 38096. The remaining seven papers were considered as not in the scope of NSA. (JRD)

For abstracts of individual papers see: 11166–11173, 11269, and 11344–11350.

11166 FRACTURE OF BORON FILAMENTS IN AN ALUMINUM MATRIX. Steele, J. H. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Herring, H. W. pp 35-42 of Advanced Materials: Composites and Carbon. Buckley, J. D. (comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466-.

Results of research devoted to the behavior of B–Al composites in uniaxial tension are presented along with results of studies on fracture mechanisms that control ultimate strength. It was found that the fracture mechanism in boron-reinforced aluminum is break propagation. This failure mode was shown to occur with a characteristic wedge-type fragmentation pattern indicating its direction. The final fracture surfaces can be single transverse failures or they can consist of steps where break propagation in more than one region was occurring simultaneously. This catastrophic failure mode occurs at filament stress levels that correspond to the weakest portion of their strength distribution. The 1230 aluminum matrix in these specimens fails by ductile shear-type fracture after the filaments are broken. (JRD)

11167 FILAMENTS FOR ADVANCED COMPOSITES: AN OVERVIEW. McCreight, L. R.; Rauch, H. W. Sr. (General Electric Co., Philadelphia). pp 43-50 of Advanced Materials: Composites and Carbon. Buckley, J. D. (comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466-.

Ceramic and intermetallic (ceramic-like) materials (such as alumina, boron, carbon, and silicon carbide) in filamentary form appear to have great promise as structural materials when used as reinforcements in various matrices. An overview and projection of these filaments and their applications is presented. Currently, the filaments are being used primarily to reinforce resins, but significant progress has been made in the use of aluminum alloy matrices. Future advances will no doubt lead to applications in which both high-temperature metals and ceramics will be reinforced with these filaments. (auth)

11168 CERAMIC EUTECTICS. Schmid, F.; Viechnicki, D. (Army Materials and Mechanics Research Center, Watertown, MA). pp 97-104 of Advanced Materials: Composites and Carbon. Buckley, J. D. (comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466-.

Metal oxide ingots with fine grain size can be fabricated by growth from the melt. An oriented lamellar-type microstructure free of cracks is developed in the Al_2O_3/ZrO_2 eutectic system by controlled solidification with the gradient furnace. The colonies inherent in ingots grown by a modified Bridgman technique were eliminated, and a lamellar-type rather than a rod-type microstructure is produced in ingots grown with the gradient furnace. Cracking does not occur at the eutectic grain boundaries as it does for polycrystalline aggregates of Al_2O_3, $MgAl_2O_4$, or $Y_3Al_5O_{12}$ solidified from the melt. (auth)

11169 PREPARATION OF CERAMIC EUTECTICS BY THE FLOATING MOLTEN ZONE TECHNIQUE. Hulse, C. O.; Batt, J. A. (United Aircraft Research Labs., East Hartford, CT). pp 133-141 of Advanced Materials: Composites and Carbon. Buckley, J. D. (comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466-.

The advantages and disadvantages of the floating molten zone technique for use in preparing directionally solidified ceramic eutectics are discussed. Resistively heated equipment which heats only by radiation or in which the melt is in direct contact with the heater is described. In the latter approach, the heater may be internal so that maximum heating efficiency results or the heater may act as a container open at both ends for the entrance and exit of the molten zone. Several novel methods for preparing the preliminary eutectic charge rods are described. Solidification parameters and microstructures for a number of ceramic systems are presented. (auth)

11170 FABRICATION OF BORON/ALUMINUM TUBES, I-BEAMS, AND OTHER STRUCTURAL SHAPES FROM TAPE MATERIALS. Weisinger, M. D.; Wiant, H. R. (General Dynamics Corp., San Diego, CA). pp 143-150 of Advanced Materials: Composites and Carbon. Buckley, J. D. (comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466-.

A program is discussed that was conducted to develop techniques for fabricating complex shapes by high-pressure consolidation of tape materials using a low-pressure gas autoclave. The tape consisted of boron filament coated with silicon carbide as a protection against elevated temperatures. The filament was held in place on a 6061 aluminum foil by plasma-sprayed aluminum. Tapes were consolidated into tubes and other structural shapes used in airframe and space applications. Encapsulation and tooling procedures were developed for I-beams, T-sections, channel shapes, and seamless tubing. The respective time, temperature, and pressure process parameters were established. A system for producing multiple flat packs in one encapsulation was devised. (IAA)

11171 PRELIMINARY INVESTIGATION OF JOINING METHODS FOR ALUMINUM–GRAPHITE COMPOSITES. Goddard, D.M.; Pepper, R. T.; Upp, J. W.; Kendall, E. G. (Aerospace Corp., El Segundo, CA). pp 151-160 of Advanced Materials: Composites and Carbon. Buckley, J. D. (comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466-.

It is shown that furnace brazing, furnace pressure welding, resistance spot welding, and gas tungsten-arc welding are suitable techniques for joining aluminum metal matrix composites to similar composites and to standard structural metals and alloys without impairing the resistance of the materials to elevated temperatures. Success with furnace brazing was possible through the discovery that aluminum-silicon-magnesium brazing alloys bond to the composites. Furnace welding appears to be best suited for producing thick multilayer composites, while spot welding ensures bonding between composites and between a composite and a commercial aluminum alloy sheet. The need for developing means of preventing metal expulsion and composite crushing is noted. (IAA)

11172 BN FIBERBOARD: A NEW FORM OF BORON NITRIDE. Highsmith, R. E.; Mason, J. H.; Economy, J. (Carborundum Co., Niagara Falls, NY). pp 161-164 of Advanced Materials: Composites and Carbon. Buckley, J. D. (comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466-.

An open porous composite form called BN fiberboard is described which consists of BN fibers in BN matrix. The material may be formed into a variety of shapes, sizes, and thicknesses by several methods, the most common of which are described. Mechanical properties and microstructures of the composites are discussed. (JRD)

11173 FABRICATION OF CARBON/GRAPHITE BOUND ELECTROCHEMICAL GRINDING WHEEL AND CORRELATION OF ITS FORMULATION VARIABLES WITH PERFORMANCE CRITERIA. Leeds, D. H. (Super-Temp Co., Sante Fe, NM); Kelly, E.; Price, J. E.; Nisula, G.; Sanders, W. E.; Weber, I. pp 213-222 of Advanced Materials: Composites and Carbon. Buckley, J. D. (comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466-.

Particulate grinding wheels were made from silicon carbide and aluminum oxide and bonded by infiltration with pyrolytic carbon for use in electrochemical grinding (ECG). Some of the wheels were subsequently heat treated at 1300°C to convert the pyrolytic carbon binder to graphite which has a better electrical conductivity than carbon (800 vs. 4000 μohm cm). Characterization of wheel compressive, flexural, and burst strength was made. Properties such as electrical resistance and sandblast coefficient were measured and correlated with formulational variables such as binder used, vol.% carbon, and the electrochemical grinding field test variables of table speed, wheel feed area, removal rate and dc amps. Results are given for wheels fabricated with pyrolytic carbon or graphitized pyrolytic carbon binders and their advantage in electrochemical grinding is shown. A copper-bonded ECG wheel was included in the study for comparison to the carbon bond. Future application in diamond wheel fabrication is indicated. (auth)

11174 MATERIAL TRANSPORT IN THE TEMPERATURE GRADIENT OF FAST REACTOR FUELS. Bober, M.; Schumacher, G. (Kernforschungszentrum, Karlsruhe, Ger.). Advan. Nucl. Sci. Technol.; 7: 121-179(1973).

The theoretical basis of thermal diffusion as far as it is necessary to understand and calculate the transport processes is

surveyed. Redistribution effects, observed in irradiated fuels as well as in out-of-pile experiments, are discussed. Thermal migration of pores and voids and thermotransport of oxygen and carbon via the gas phase are included in the considerations because they can also be described on the basis of thermal diffusion processes. It is shown that the thermal diffusion effects developing in fast reactor fuel pins can be analyzed using suitable data sets obtained from experimental results. (14 figures, 72 references) (LMT)

11175 DIFFUSIONAL CREEP OF URANIUM DIOXIDE: ITS LIMITATION BY INTERFACIAL PROCESSES. Burton, B.; Reynolds, G. L. (Central Electricity Generating Board, Berkeley, Eng.). Acta Met.; 21: No. 8, 1073-1078(Aug 1973).

Creep tests were performed on stoichiometric uranium dioxide in the range where diffusional creep is expected to predominate. The stress index of unity which characterizes diffusional creep was only approached at the highest test temperatures and over a narrow stress range. Thereafter the stress index became increasingly large as creep rates fell to very low values, indicating that diffusional creep was being suppressed in these cases, and this suppression was more pronounced at lower temperatures. This is contrary to the predictions of simple diffusion theory which lead only to an enhancement of diffusion creep at lower temperature owing to contributions by grain boundary diffusion. Creep behavior could best be described by the equation $\dot{\varepsilon} \propto (\sigma - \sigma_0)$ where σ_0 is a threshold stress below which diffusional creep does not contribute and varies with temperature in a manner described by the equation $\sigma_0 = A \exp(U/RT)$ where $A = 130\ N/m^2$ and $U = 1.5 \times 10^5$ J/mol. The implications of this temperature-dependent σ_0 term are discussed and results are interpreted in terms of the limitation of diffusional creep by interfacial processes. (auth)

11176 APPLICATIONS OF VACUUM SCIENCES AND TECHNOLOGY TO SURFACE COATINGS AND SURFACE STATES. Second International Conference, Lyon, France, September 19, 1972. Paris; Societe Francaise des Ingenieurs et TechniscIens du Vide (1972). 349p. (In French, English, and German).

Sixty-five papers were presented at the conference. One paper has appeared previously in NSA; see abstract 27:28108. The remaining papers were not in scope for NSA. (TFD)

11177 PREPARATION OF UO_2 MICROSPHERES WITH CONTROLLED POROSITY FROM A URANYL NITRATE SOLUTION. Foerthmann, R.; Blass, G. (Kernforschungsanlage, Juelich, Ger.). Journal of Nuclear Materials; 47: No. 2, 259-261(Jun 1973).

The application of the H-process (hydrolysis process) for fabrication of porous UO_2 microspheres is described. In the process, urea and hexamethylentetramine are added to the uranyl nitrate solution, and the solution is then dropped into hot oil to solidify droplets by homogeneous hydrolysis and to form spherical particles which in turn are washed, dried, and sintered. Porosity to the desired extent is produced by adding carbon powder to the starting solution and carrying out the drying step at ≤800°C to burn out the carbon. The reproducibility of the porosity is very satisfactory, and it is stable at high temperatures. (DLC)

11178 FERRIMAGNETIC PROPERTIES OF $Eu_3Ti_2O_7$. Chien, C. L. (Carnegie-Mellon Univ., Pittsburgh); DeBenedetti, S.; Barros, F. De. S. Phys. Lett., A; 44A: No. 3, 178-180(4 Jun 1973).

The Moessbauer spectrum of $^{151}Eu_3Ti_2O_7$ reveals a ferrimagnetic ordering below (8 ± 0.3) °K with two inequivalent sites in ratio 2:1, and with exchange constants nearly equal to those of $EuTiO_3$ and of Eu_2TiO_4. The sublattice magnetizations are explained in terms of these constants. (auth)

11179 DIRECT OBSERVATION OF EXTENDED LINEAR DEFECTS IN MgF_2-DOPED NIOBIUM OXIDES. Hutchison, J. L.; Lincoln, F. J. (Oxford Univ.). Phys. Status Solidi (a); 17: No. 1, 169-174(16 May 1973).

MgF_2–Nb_2O_5 mixtures were heat treated to form complex oxides possessing "block structures." By means of high-resolution electron microscopy, it is possible to observe the component blocks and to identify defects at the unit cell level. Interaction of planar defects within such crystals gives rise to anomalous structures, including hitherto unreported extended linear defects in the form of rectangular tunnels. Their cross section, 2.8 × 5.6 Å², is within the resolving power of the electron microscope, and at the appropriate defocus they appear as white streaks in the lattice image. (auth)

11180 PHASE TRANSITION OF V_6O_{13}. Kawada, I.; Nakano, M.; Saeki, M.; Ishii, M.; Kimizuka, N.; Nakahira, M. (National Inst. for Researches in Inorganic Materials, Ibaraki, Japan). J. Less-Common Metals; 32: No. 1, 171-172(Jul 1973).

Lattice constants, unit-cell volumes, and space groups were determined at room temperature (RT) and 77°K. The powder-diffraction pattern at 77°K was also indexed. The volume change, $V_{RT} - V_{77°K}$, is negative, and the transition is of first order. The space groups of the RT and 77°K phases are C2/m and $P2_1/a$, respectively. (DLC)

11181 THERMAL CONDUCTIVITY OF COATINGS OF ZIRCONIUM DIOXIDE APPLIED BY THE PLASMA SPUTTERING METHOD. Lapshov, V. N.; Bashkatov, A. V. Heat Transfer–Sov. Res.; 5: No. 2, 19-22(1973).

The studies were made in the range 300 to 1500°C using ZrO_2 layers sputtered onto various metals bonded to W substrate. The experimental results are presented in thermal conductivity vs temperature curves. (JRD)

11182 ELECTRICAL PROPERTIES OF CARBIDES OF TRANSITION METALS OF GROUP IV IN THE 20 TO 2000°C TEMPERATURE RANGE. Golikova, O. A.; Dzhafarov, E. O.; Avgustinik, A. I.; Klimeshin, G. M. Heat Transfer–Sov. Res.; 5: No. 2, 11-14(1973).

The electric properties of TiC and ZrC are reviewed. It is noted that research results have not revealed whether these materials are semiconductors or whether they conduct as metals. Low-temperature properties of TiC_x and ZrC_x can be interpreted as semiconductor properties, but this conclusion cannot be considered final. The semiconductor question can be answered by studying the absorption spectra in the indicated interval; but because of inherent high current-carrier concentrations in these carbides, such studies are faced with complex experimental problems and have not been conducted. (JRD)

11183 NEW COMPOUNDS OF LANTHANIDE OXIDES WITH ANTIMONY TRIOXIDE. Adachi, G.; Ishihara, M.; Shiokawa, J. (Osaka Univ.). J. Less-Common Metals; 32: No. 1, 175-177.

A series of new compounds $2\ Ln_2O_3 \cdot xSb_2O_3$ (x = 3.0 to 3.8, Ln = La, Pr, or Nd) were obtained by solid-state reactions. Tetragonal lattices were formed in the La and Pr series; tetragonal and cubic lattices were formed in the Nd series. The tetragonal lattice parameters were determined to be a = 5.05 Å and c = 9.04 Å for La, a = 4.99 Å and c = 9.02 Å for Pr, and a = 4.98 Å and c = 9.02 Å for Nd; for the Nd cubic lattice, a = 11.000 Å. Sm_2O_3 and Gd_2O_3 did not react with Sb_2O_3. (DLC)

11184 THERMAL CONDUCTIVITY OF YTTRIUM OXIDE IN THE 600 TO 2100°K RANGE. Chekhovskoi, V. Ya.; Stavrovskii, G. I.; Pustil'nik, A. I.; Sedykh, T. S.; Ivanov, A. B. Heat Transfer-Sov. Res.; 5: No. 2, 68-70(1973).

The measurements were made by the tube method using a steady radiant heat flux from an axial tungsten heater. Data on the thermal conductivity of Y_2O_3 at 100°C intervals from 400 to 1400°C are given. (JRD)

11185 INTEGRAL HEMISPHERICAL RADIATIVITY OF PYROLYTIC SILICON AND ZIRCONIUM CARBIDES. Petrov, V. A.; Cherkhovskoi, V. Ya.; Sheindlin, A. E.; Dymov, B. K. Heat Transfer-Sov. Res.; 5: No. 2, 65-67(1973).

Coatings of Si and Zr carbide were obtained by interaction between the corresponding metal chloride and methane at high temperature and were deposited on graphite substrates. The test specimens were electrically heated in vacuum. Data are presented on integral hemispherical radiativity of pyrolytic ZrC and SiC at 1200 to 2900°K. (JRD)

11186 $U_{0.8}Pu_{0.2}$ C–W SYSTEM. Ugajin, M. (Japan Atomic Energy Research Inst., Tokai). Journal of Nuclear Materials; 47: No. 2, 205-218(Jun 1973).

A phase diagram of the $U_{0.8}Pu_{0.2}$ C–W system was established based on x-ray diffraction measurements and metallographic observations. A peritectic four-phase reaction was found to occur at 2100 ± 40°C: (U,Pu)C + W $\underset{\text{cooling}}{\overset{\text{heating}}{\rightleftharpoons}}$ $(U,Pu)WC_{1-75}$ + liquid. The peritectic point is close to $U_{0.8}Pu_{0.2}$ C–27 wt % W. Composition of the peritectic liquid is near 48(U + Pu)/18W/34C (at. %) by analogy with the UC–W system. The liquid phase transforms, during rapid cooling, to a metastable mixture [(U,Pu)C + (U,Pu)metal + W] with accompanied retention of $(U,Pu)WC_{1-75}$. The $(U,Pu)WC_{1-75}$ phase crystallizes in a UWC_{1-75}-type monoclinic structure. Essentially single-phase $(U_{0.8}Pu_{0.2})WC_{1-75}$ was produced by sufficient annealing of the arc-melted specimen, with lattice parameters: $a_0 = 5.6257 \pm 0.0008$ Å, $b_0 = 3.2498 \pm 0.0005$ Å, $c_0 = 11.623 \pm 0.002$ Å, $\beta = 109.61 \pm 0.01°$. This compound perhaps melts incongruently as: (U,PU)WC_{1-75}(monoclinic) $\underset{\text{cooling}}{\overset{\text{heating}}{\rightleftharpoons}}$ (U,PU)WC_2(orthorhombic) + liquid, (T > 2200°C). The terminal solid solubility limit of tungsten in $U_{0.8}Pu_{0.2}C$ increases from about 0.8 wt % W at 1500°C to a maximum of about 3.2 wt % W at 2100°C. The partial molar heat of solution of tungsten in $U_{0.8}Pu_{0.2}C$ is approximately 14.4 kcal/mole. (9 figures, 19 references) (auth)

11187 DETERMINATION OF CONCENTRATION OF NITROGEN IN A Nb–N–O SOLID SOLUTION. Ageev, M. N.; Ivanov, A. N.; Umanskii, Ya. S. (Moscow Inst. of Steel and Steel Alloys). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 117-120(1973). (In Russian).

A description is given of the determination of N in Nb in the presence of O based on measurements of solid solution lattice constants, specific electrical resistance, and the Snoek relaxation peak height. Graphs are provided which illustrate the linear relations of these parameters with the concentration of N over a range 0 to 1% N. (KSW)

11188 ESTIMATION OF THE SURFACE OXYGEN BOND ENERGY IN OXIDES OF GROUP IV TRANSITION METALS. Bulgakov, N. N.; Borisov, Yu. A.; Popovskii, V. V. (Inst. of Catalysis, Novosibirsk, USSR). Kinet. Katal.; 14: No. 2, 468-476(1973). (In Russian).

A model is proposed in which an oxide is regarded as an aggregate of interacting bonds between neighboring metal atoms and oxygen. The heat of atomization of the complex multi-atom system is approximately expressed through the semiempirical parameters E_{MeO} and ϵ_{MeO} which characterize the stability of the isolated MeO bond, semi-empirical parameters Δ_{MeO} and Δ_O which characterize the interaction between bonds converging on a metal atom and an oxygen atom, respectively, and the bond coefficient ν which is determined from conditions of minimum energy (maximum heat of atomization). The parameters E_{MeO}, ϵ_{MeO}, Δ_{MeO} and Δ_O are determined from the heat of formation of the oxides and are then employed in calculations of the surface bond energies and the bond stability of the dissociated chemisorbed oxygen. The theoretical values of the heat of chemisorption agree with experimental values. A dissociated form of chemisorbed oxygen undoubtedly plays a role as active oxygen; in this an oxygen atom is bonded to one metal atom. (tr-auth)

11189 COMBUSTIBILITY OF METALLIC POWDERS OF SOME REFRACTORY AND RARE EARTH METALS AND THEIR BORIDES. Manuev, N. V.; Popov, E. I.; Poyarkov, V. G.; Finaev, Yu. A. Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz. Energ. Navuk; No. 3, 132-135(1972). (In Russian).

The flammability temperatures of powdered forms of Zr, ZrB_2, Hf, HfB_2, TiB_2, EuB_6, SmB_6, and Ni were determined in both dry and moist (100% relative humidity) air by a differential-thermographic method of analysis. The particle size of the metallic powders ranged from 50 to 63 μ. The presence of humid air caused a 40 to 50°C increase in the flammability temperatures of Zr, CrB_2, and HfB_2; a similar decrease was noted for powdered Ni. Smaller changes in the flammability temperatures were observed for the other materials cited above. (KSW)

11190 HEAT CAPACITY OF $RbMnF_3$ AND EuO NEAR THE MAGNETIC PHASE TRANSITIONS. Kornblit, A.; Ahlers, G.; Buehler, E. (Bell Labs., Murray Hill, NJ). Phys. Lett.; 43A: No. 6, 531-532(23 Apr 1973).

Precision measurements of C_p near the antiferromagnetic transition in $RbMnF_3$ and near the ferromagnetic transition in EuO yield critical exponents $\alpha = \alpha' = -0.14$ and $\alpha = \alpha' = -0.04$ respectively. (auth)

11191 EMPIRICAL BAND SCHEME FOR RHOMBOHEDRAL V_2O_3. Balberg, I. (RCA Labs., Princeton, NJ). Phys. Lett.; 43A: No. 6, 497-498(23 Apr 1973).

The available optical and soft x-ray data are shown to yield a consistent picture of band separations in V_2O_3. The resulting band scheme is in accord with the band model for this material. (auth)

11192 DIFFUSION OF PLUTONIUM AND URANIUM IN IRRADIATED MIXED-OXIDE FUEL. Butler, E. M.; Meyer, R. O. (Argonne National Lab., Illinois). Journal of Nuclear Materials; 47: No. 2, 229-240(Jun 1973).

Interdiffusion coefficients were measured in two uniquely fabricated slightly hypostoichiometric $(U,Pu)O_2$ fuel rods. The measured results can be expressed as $\tilde{D} = 1 \times 10^{-5} \exp(-61{,}000/RT)$ and $\tilde{D} = 1 \times 10^{-5} \exp(-53{,}000/RT)$ for the fuel with burnups of 3.5 and 10 at. %, respectively. No radiation enhancement of the diffusion coefficients was observed between ~1000 and ~2000°C. Effects of fission-product impurities and oxygen concentration gradients, which are discussed in terms of the Lidiard model for lattice disorder, are thought to be partially responsible for the observed low activation energies. Effects of diffusion short circuiting are also important. The diffusion measurements were made in fuels irradiated under typical fast-breeder reactor conditions, and the results are directly applicable to a description of processes that affect fast-breeder reactor fuel performance. (auth)

11193 PLUTONIUM REDISTRIBUTION IN FAST-REACTOR MIXED-OXIDE FUEL PINS. Bober, M. (Kernforschungszentrum, Karlsruhe, Ger.); Schumacher, G.; Geithoff, D. Journal of Nuclear Materials; 47: No. 2, 187-197(Jun 1973).

Some redistribution effects of uranium and plutonium, caused by thermal diffusion and evaporation-condensation processes in mixed oxide fuels, are discussed by means of autoradiographs of sections of fuel pins irradiated in the fast flux of the RAPSODIE reactor. The change in the stoichiometric state as a function of burnup and the radial distribution of oxygen are described and their influence on the redistribution processes is discussed. A model and suitable data are given to calculate redistribution effects on the basis of thermal diffusion in fast reactor fuels. In fuel pins with power ratings of 500 and 600 W/cm, the enrichment of plutonium around the central cavity produces an increase in the central temperature of about 100 and 250°C, respectively. (8 figures, 32 references) (auth)

11194 SIMULATION OF IN-PILE RADIAL TEMPERATURE PROFILES IN MIXED-OXIDE FUEL PINS. Quik, F.; Sari, C. (EURATOM, Karlsruhe, Ger.). Journal of Nuclear Materials; 47: No. 2, 219-228(Jun 1973).

Temperature profiles similar to those existing in fuel rods under irradiation were simulated by passing electrical current through cylindrical pellets. Comparison between calculated and measured temperatures in pellets heated in a thermal gradient shows: (1) The values of thermal conductivity obtained by different authors in isothermal experiments and extrapolated to temperatures up to 2700°C are not in agreement. Therefore, the calculation of the temperature of the fuel leads to errors which vary between 1 and 16% depending on the data for λ used. For central temperatures above 1900°C, the values of Schmidt better suit the calculations, especially if the oxygen content of the fuel is smaller than 2.00. (2) The published data of electrical conductivity are in open disagreement. The values of activation energy are generally higher than those deduced from the present investigation. It has been assumed that the activation energy E in the equation $\sigma = A \exp(-E(T)/kT)$ varies with temperature as $E(T) = E_0(1 - 1.94 \times 10^{-4}\ T)$ when $E_0 = 0.58$ eV if O/M = 2.00, and $E(T) = E_0(1 - 2.21 \times 10^{-4}\ T)$ when $E_0 = 0.91$ eV if O/M = 1.94. (auth)

11195 CONSERVATION EQUATIONS GOVERNING POROSITY AND ACTINIDE REDISTRIBUTION IN MIXED-OXIDE FUELS. Olander, D. R. (Univ. of California, Berkeley). Journal of Nuclear Materials; 47: No. 2, 251-254(Jun 1973).

Equations are derived for the conservation of pores, total mass, and plutonium. It is suggested that pore migration probably alters the conditions necessary for actinide redistribution by vapor transport along radial cracks or interconnected porosity. (DLC)

11196 MEASUREMENTS OF CRACK SINTERING RATES IN UO_2 PELLETS. Ainscough, J. B.; Rigby, F. (United Kingdom Atomic Energy Agency, Springfields, Eng.). Journal of Nuclear Materials; 47: No. 2, 246-250(Jun 1973).

Measurements were made of the crack healing rate and rupture load in UO_2 rings. For the healing measurements, segments were ground off from the samples leaving a minimum wall thickness of 0.25 mm, and cracks were introduced into this minimum thickness. A 0.5-mm slit was cut into the ring opposite the flat surface of the minimum wall thickness, leaving a thickness of 0.64-mm between slit base and bore surface. Samples were loaded while cold and then heated in flowing H_2. (DLC)

11197 EFFECT OF OXYGEN-TO-METAL RATIO ON PLUTONIUM REDISTRIBUTION IN IRRADIATED MIXED OXIDE FUELS. Meyer, R. O.; O'Boyle, D. R.; Butler, E. M. (Argonne National Lab., IL). Journal of Nuclear Materials; 47: No. 2, 265-267(Jun 1973).

Plutonium enrichment near the central void occurs for nearly stoichiometric $(U,Pu)O_2$, and conversely uranium enrichment occurs for low O/M ratios. Results from postirradiation examinations of ten pellet-type fuel elements are presented as a change-of-Pu fraction vs initial O/M ratio graphs for the fuel element centerline. The point of zero change occurs at O/M = 1.96, and the magnitude of the Pu depletion at low O/M ratios is much less than the enrichment at high O/M ratios. This effect is explained on the basis of the vapor-transport mechanism (total vapor pressure decreases with lower O/M ratio). Fuel-porosity and temperature effects are also noted. (DLC)

11198 RADIATSIONNAYA FIZIKA NEMETALLICHESKIKH KRISTALLOV. (Radiation Physics of Nonmetallic Crystals). Siroga, N. N. (ed.). Minsk; Izdatel'stvo Nauka i Tekhnika (1970). 256p.

The collection of 36 papers by different authors discusses theoretical and experimental investigations of the nature and mechanism of radiation damage, and the kinetics of formation and the annealing of radiation defects in nonmetallic crystals. The effects of radiation on elemental semiconductors, semi-

conducting compounds, and n–p junctions are studied. The radiation sources considered include reactors, accelerators, and γ installations such as ^{60}Co. (KSW)

11199 COATINGS OF HIGH-TEMPERATURE MATERIALS. Part 1, Part 2, and Part 3. Hausner, H. H. (ed.). New York; Plenum Publishing Corporation (1966). 303p. $20.00.

The book is divided into three parts. A separate abstract was prepared for each part. (JRD)

For abstracts of individual sections see: 11200, 11214, and 11296.

11200 COATINGS OF HIGH-TEMPERATURE MATERIALS. Samsonov, G. V.; Epik, A. P. pp 1-111(Pt.1) of Coatings of High-Temperature Materials. Pts. 1, 2, and 3. Hausner, H. H. (ed.). New York; Plenum Publishing Corp. (1966).

Development and uses of high-temperature coatings are reviewed. Information and data are included on boride coatings, carbide coatings, nitride coatings, and silicide coatings. (89 references) (JRD)

11201 RHENIUM OXIDE IN RELATION TO V_2O_5 STRUCTURE. Colaitis, D.; Lebas, D.; Lecaille, C. (Laboratoire de Chimie des Solides, Paris). Mater. Res. Bull.; 8: No. 6, 627-634(Jun 1973). (In French).

Re_2O_5 was revealed and investigated by means of transmission electron microscopy and single diffraction. The orthorhombic unit cell is related to the ReO_3 cubic cell in terms of: $b = c = a_C = 3{,}747$ Å and $a = 2\,a_C\sqrt{2} = 10{,}598$ Å. The crystal structure is explained from patterns, according to the structural scheme of Me_2O_5, and particularly to the V_2O_5 structure. It is obvious that there exists a close relationship between them. (auth)

11202 STUDY BY ELECTRON MICROSCOPY OF MOVEMENTS AT THE SURFACE OF THIN LAYERS OF RARE-EARTH SESQUIOXIDE CRYSTALS. Portier, R. (ENSCP, Paris); Fayard, M.; Boulesteix, C.; Caro, P. E. Mater. Res. Bull.; 8: No. 6, 693-702(Jun 1973). (In French).

Evaporated rare earth sheets were oxidized and observed in an electron microscope. Observations indicate the existence of numerous and various steps on the surfaces of oxide crystals. The formation of these steps is related to the cubic–transformation monoclinic. The steps are generally parallel to the faces of the tetrahedra 0 Ln_4, the linkage of which constitutes the layers of the layered oxide structure. (auth)

11203 CHANGE IN THE PARAMETERS OF GAMMA RESONANCE SPECTROSCOPY OF IRON OXIDE CATALYSTS UNDER THE INFLUENCE OF IONIZING RADIATION FROM A NUCLEAR REACTOR. Sokol'skii, D. V.; Khlystov, A. S.; Kuz'minov, A. V.; Nadykto, B. T. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 21-24(1972). (In Russian).

Iron oxide catalysts were subjected to reactor radiation (neutron/γ), using the ^{57}Fe Moessbauer effect to study the effects of the ionizing radiation. The parameters of gamma resonance spectroscopy, isomeric shifts, and quadrupole splitting, were altered to an insignificant degree. Other changes were correlated with catalytic activity. (tr-auth)

Metals and Alloys

Refer also to abstracts 11139, 11151, 11160, and 11165.

11204 REACTION OF ZIRCONIUM-NIOBIUM ALLOYS WITH NITROGEN. Yanchur, V. P.; Andrievskii, R. A.; Kalinin, V. P.; Lyubel'skaya, R. N. Fiz. Khim. Obrab. Mater.; No. 1, 124-129 (1973). (In Russian).

Four Zr–Bn alloys containing 5.5, 10.1, 49.5, and 81.6 wt % Nb were nitrided at temperatures 1500 to 1600°C with greater ease than the pure metals alone. This contrast was associated with the incomplete crystal structure residing in phase transformations in the Zr–Nb system. A redistribution of metallic components in the alloys resulted from the nitriding process. (tr-auth)

Corrosion and Erosion

Refer also to abstracts 11199, 11200, 11336, and 11337.

11205 (AWRE-O-22/73) STRESS CORROSION TESTING USING A POTENTIOSTATIC DYNAMIC STRAIN TECHNIQUE. Brettle, J.; Orman, S. (Atomic Weapons Research Establishment, Aldermaston (England)). Apr 1973. 50p. Dep. NTIS (U. S. Sales Only) $3.00. UK 14 pence.

A simple test to enable rapid identification of alloy–environment systems susceptible to stress corrosion cracking has been described previously. The test has proved to be satisfactory for highly susceptible systems when large changes in tensile properties and fracture mode are observed, but less so for mildly susceptible systems when the changes in properties are less marked. The scope of the test has been widened by incorporating potentiostatic control. This enables a wider range of environmental conditions to be examined and leads to a more basic understanding of the factors controlling the stress corrosion mechanism. Results are presented for U, Ti, and Ti–8Al–1Mo–1V. 21 references. 6 figures. (auth)

11206 (DUN-8075) ANALYSIS OF WEAR TEST COMPARING ZIRCALOY-2 ON ZIRCALOY-2 VERSUS 1010 STEEL ON ZIRCALOY-2. Fields, K. E. (Douglas United Nuclear, Inc., Richland, Wash.). 12 Feb 1973. 20p. Dep. NTIS $3.00.

Tests were conducted with a wear test machine and a flush discharge mockup to compare the debris generation characteristics of an autoclaved Zircaloy-2 fuel element support and a fuel element support fitted with a 1010 steel shoe. Testing parameters with the wear tester included simulated charging velocities of 37, 50, 60, and 80 feet/minute, and support contact loads of 12.5, 25, 50, 75, and 100 pounds. Testing in the flush discharge mockup was conducted at charging velocities of 50 and 95 feet/minute using a sixteen piece Mark-IV fuel column. In addition, a test to determine the effect of back pressure on debris generation was performed in the mockup. Results of the testing confirm the results of earlier studies that the interaction between Zircaloy-2 on Zircaloy-2 produces significantly more debris than the interaction of 1010 steel on Zircaloy-2. The results of the tests also show that: 1) charge–discharge speed is a prime factor in debris generation with the optimum charge-discharge speed being a nominal 50 feet/minute; and 2) a slight back pressure on a fuel column (such as might be caused by a cocked fuel or spacer or if the rear face "tip-off" were not aligned to the process tube to provide a smooth transition for the fuel elements from the process tube to the tip off) significantly increases debris generation. (auth)

11207 (EURFNR-1087) INFLUENCE OF COLD WORK ON THE CORROSION RESISTANCE OF AUSTENITIC CrNi STEELS IN SUPERHEATED STEAM. Part 3. Static Autoclave Investigations on Material 1.4301 (X5 CrNi 18 9). Leistikow, S.; Pott, E.; Volz, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Mar 1973. 34p. Dep. NTIS $3.75.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Continuing the basic studies of the influence of various degrees of cold work and grain sizes upon the corrosion behavior of austenitic stainless steels, sheet specimens of a 18-9 CrNi steel (AISI 304 ss) were tested in static high-pressure steam autoclaves during runs of 1000 hours at 600°C, 70 atm. Cold-worked sheet specimens were produced by cold rolling, reducing the original thickness of 1 mm to 10 to 70%, and grinding. Coarse-grain sheet specimens were made by one-hour-annealing treatments in an inert atmosphere at 900 to 1300°C, resulting in bulk structures of 20 to 160 μ medium grain diameter. The specimens were inserted for corrosion testing in an electropolished surface condition. The experiments resulted in a substantial increase of corrosion resistance by the cold working and grain refining pretreatments which increased the defect concentration. Heat treatments, reducing the number of defects and forming coarse grain structures, decreased the corrosion resistance. Oxidation mechanisms found effective were: thermodynamically favored chromium oxide and spinel layer formation by inward diffusion of oxygen ions; dependency of the defect concentration on the selective chromium oxidation; high diffusivity of chromium in a bulk structure of high defect concentration, especially in the grain boundaries, which are acting as easy diffusion paths; and the extraordinary protective character of chromium-rich oxide layers preventing the outside diffusion of iron and nickel ions in the second oxide-phase-forming process. Results of the corrosion tests after different pretreatments are the basis for the following extreme values of metal losses for AISI 304 ss: as received, ground (17 mg/dm^2); and annealed 1 hr at 1300°C (2240 mg/dm^2). This variety of corrosion behavior should not be neglected if for technical application a choice of a suitable material has to be made. (auth)

11208 (NAA-SR-8617(Vol.1)(Add.1)) SNAP TECHNOLOGY HANDBOOK. Volume 1, Addendum 1. Liquid Metals. Burdi, G. F. (Atomics International, Canoga Park, Calif.). 30 May 1964. Contract AT(11-1)-Gen-8. 14p. Dep. NTIS $3.00.

Declassified 3 May 1973.

Data are presented on forced convection heat transfer by NaK in a SNAP 2 counterflow shell and tube boiler. Data are also included on corrosive effects of flowing Hg, K, and Li on pipes and tubes made of heat-resisting alloys and refractory metals at 1200 to 2950°F. (JRD)

11209 (NAA-SR-11951) OXIDATION KINETIC STUDIES ON SNAP FUELS. Young, W. A. (Atomics International, Canoga Park, Calif.). 15 Jun 1966. Contract AT(11-1)-Gen-8. 50p. Dep. NTIS $4.50.

Declassified 24 May 1973.

Isothermal rate constants were obtained for the oxidation of nonhydrided SNAP fuel for the range of 570 to 1190°C. In addition, a study was made of the behavior of hydrided and of nonhydrided SNAP fuel alloy subjected to air oxidation under a temperature transient typical of that to be expected upon atmospheric reentry. The temperatures attained during this latter study approached 1700°C. (auth)

11210 (NAA-SR-Memo-10914) OXIDATION KINETICS OF SNAP FUEL ALLOY, MODIFIED 90-10 ZIRCONIUM-URANIUM. Harkness, S. D. (Atomics International, Canoga Park, Calif.). 18 Jan 1965. Contract AT(11-1)-Gen-8. 33p. Dep. NTIS $3.75.

Declassified 24 May 1973.

Oxidation kinetic rate constants for 90-10 modified zirconium-uranium alloy are presented for the temperature range 575 to 1190°C. These studies resulted in the following expressions for the rate constants: $\log K(mg^2/cm^4\ sec) = 1.01 \pm 0.84 - [(1.93 \pm 0.34)10^4/4.576\ T]$ (843 to 1113°K), $\log K(mg^2/cm^4\ sec) = 2.87 \pm 0.63 - [(2.60 \pm 0.29)10^4/4.576\ T]$ (893 to 1043°K), and $\log K(mg^2/cm^4\ sec) = 10.2 \pm 0.7 - [(6.60 \pm 0.42)10^4/4.576\ T]$ (1113 to 1463°K). The last expression is expected to be valid to the melting point. The small amount (0.15 wt %) of carbon in the samples and the presence of nitrogen in the atmosphere do not significantly affect oxidation rates. The addition of uranium to zirconium however, appears to increase the activation energy of the process and to reduce the temperature range over which a cubic fit is obtained. Spalling of the samples appeared to occur for the modified 90-10 zirconium-uranium alloy only from 650 to 900°C, at times greater than 30 minutes. Metallographic studies, experimental apparatus and procedures are described. (auth)

11211 (ORNL-TM-4172) CORROSION OF TYPE 304L STAINLESS STEEL AND HASTELLOY N BY MIXTURES OF BORON TRIFLUORIDE, AIR, AND ARGON. Koger, J. W. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 18p. Dep. NTIS $3.00.

Corrosion of type 304L stainless steel and Hastelloy N was studied in gaseous mixtures of BF_3, air, and argon at 600, 300, and 200°C. In some tests the alloy specimens and gases were in contact with molten fluoride mixtures. At 600°C under air, specimens of both alloys were completely destroyed in both fuel salt and fluoroborate salt mixtures. No significant weight changes were measured for Hastelloy N immersed in salt exposed to argon or BF_3, but type 304L stainless steel lost weight under the same conditions. This weight loss was greater under BF_3 than under argon and greater in the fluoroborate mixture than in the fuel salt. With no salt immersion, the various gases produced very small changes in the alloys at 200°C. Also with no salt, only small changes were noted at 300 and 600°C for Hastelloy N in any gas and for the stainless steel in air. At 600°C, large quantities of chromium and iron oxides were produced on the stainless steel by the air-BF_3 mixture and large amounts of unidentified corrosion products by BF_3, argon-BF_3, and argon-air. Drying the argon decreased the amount of corrosion. Hastelloy N was more resistant than type 304L stainless steel to corrosion by the gases tested in these experiments. (auth)

11212 STRESS-CORROSION CRACKING OF ALUMINUM-COATED U-4.5 wt % Nb. Macki, J. M.; Mah, G.; Kochen, R. L.; Nordin, C. W. (Dow Chemical Co., Golden, CO). Journal of Nuclear Materials; 47: No. 2, 173-176(Jun 1973).

Room-temperature (26 ± 2°C) tests show that the aged (80 h at 260°C) U-4.5 wt % Nb alloy can be protected from stress-corrosion cracking in aqueous chloride environments by coating the alloy with aluminum. (auth)

11213 FAILURE MECHANISMS OF ALUMINIDE AND SILICIDE COATINGS ON A NIOBIUM ALLOY SUBJECTED TO THERMAL CYCLING IN AIR. Weber, R. G.; Bouvier, J.; Slama, G. (Ecole des Mines, Paris). J. Less-Common Metals; 32: No. 1, 1-20(Jul 1973).

Failure during thermal cycling in air of silicide and aluminide coatings on a niobium-base alloy was investigated and failure mechanisms proposed. Most failures occurred at or very near geometrical transitions between the curved and flat sections of the specimen. In the neighborhood of these transitions, cracks form in the coating at oblique angles to the specimen surface due to nonuniform deformation induced by the thermal stress. These oblique cracks allow easy detachment of coating segments and exposure of the substrate to the oxidizing environment. Cracks in aluminide coatings were found to multiply much more rapidly during cycling than in silicide coatings. This leads to the development of numerous oblique cracks and consequently the protective life of aluminide coatings is well below that of silicide coatings. (auth)

11214 COATINGS ON REFRACTORY METALS. Leeds, D. H. pp 207-296(Pt.3) of Coatings of High-Temperature Materials. Pts. 1, 2, and 3. Hausner, H. H. (ed.). New York; Plenum Publishing Corp. (1966).

Properties of protective coatings for refractory metals are reviewed. Emphasis is placed on materials for use in construction of reentry vehicles. Discussion and data are included on refractory metals, pack cementation coatings, protective life of coatings, and plasma facilities. (JRD)

11215 COMPATIBILITY OF REFRACTORY METALS WITH $^{244}Cm_2O_3$. DiStefano, J. R.; Lin, K. H. (Oak Ridge National Lab., TN). Nucl. Technol.; 19: No. 1, 34-45(Jul 1973).

The power density of $^{244}Cm_2O_3$ makes it an attractive fuel form for a variety of radioisotopic applications. To evaluate the compatibility of $^{244}Cm_2O_3$ with refractory metals for high-temperature applications, Ta, Ta-10 wt % W, T-111, Mo, TZM, W, and W-26 wt % Re were tested at 1650 and 1850°C, and Nb, Nb-1 wt % Zr, Ta, Ta-10 wt % W, Mo, V, and Zr were tested at 1250°C for times up to 10,000 h. Reactions of $^{244}Cm_2O_3$ with Zr occurred at 1250°C and with Ta-10 wt % W and T-111 at 1650°C. At both 1250 and 1650°C, the remaining materials showed good resistance to $^{244}Cm_2O_3$ with only limited attack, mainly in the form of shallow intergranular subsurface voids. At 1850°C, there was evidence of dissolution of tantalum and the tantalum alloys by $^{244}Cm_2O_3$. After 5000 and 10,000 h, tantalum transferred from one portion of the capsule to another, and tantalum particles were found in the fuel. Less-extensive mass transfer was noted with the other materials, although significant amounts of tungsten from the unalloyed tungsten and W-26 wt % Re tests were found in the fuel. (auth)

11216 MONITORING AND MEASUREMENT OF CARBON ACTIVITY IN SODIUM SYSTEMS. Natesan, K.; Kassner, T. F. (Argonne National Lab., IL). Nucl. Technol.; 19: No. 1, 46-57 (Jul 1973).

An equilibration method has been developed to measure accurately the activity of carbon in liquid sodium. Foils of Fe-8 wt % Ni, Fe-16 wt % Ni, and Fe-18 wt % Cr-8 wt % Ni alloys can be exposed to liquid sodium at temperatures between 650 and 800°C for times necessary to achieve 99% of the equilibrium carbon concentration in the alloys. The carbon activity-concentration relationships for these materials, based on the graphite standard state, were determined from equilibration experiments in CH_4-H_2 gas mixtures. Carbon activity measurements in flowing sodium at 750°C by the foil equilibration method were used to calibrate the response of a diffusion-type carbon meter that was useful in monitoring the carbon activity in sodium. No correlation was obtained between measured carbon activities by the foil equilibration method, in the low activity range of interest in reactor sodium systems, and either carbon analyses of sodium samples or the response of an electrochemical carbon meter. (auth)

Preparation and Fabrication

Refer also to abstracts 11142 and 11367.

11217 (BARC-645) DC PLASMA TORCH FOR METAL CUTTING. Jayakumar; Paithankar, A. S. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 34p. Dep. NTIS (U.S. Sales Only) $3.75.

A plasma process is described in detail for cutting metals like stainless steel, mild steel, and other alloy steels. The design, construction, and performance of the 100-kW dc plasma metal cutting torch are presented. The merit of the dc plasma process over conventional methods is discussed. Operational data and safety measures are also prescribed. (auth)

11218 (ORNL-TM-4055, pp 2.1-2.37) STEAM GENERATOR AND HEAT EXCHANGER MATERIALS. Jan 1973.

In fuels and materials development program quarterly progress report.

Activities in programs devoted to development of methods for fabricating and inspecting components for steam generators and heat exchangers are summarized. Information and data are included on examination of the Alco/BLH steam generator, stress corrosion cracking of boiler materials, sodium chloride corrosion reactions, fabrication and properties of heat exchanger and steam generator parts, and nondestructive testing. (JRD)

11219 (ORNL-TM-4055, pp 5.1-5.68) WELDING DEVELOPMENT: FBR COMPONENTS. Jan 1973.

In fuels and materials development program quarterly progress report.

The behavior of weldments in austenitic stainless steel at 370 to 750°C as a function of both welding process and the variables

within a process is being evaluated for application to LMFBR vessels and components. The investigation covers both heavy-section weldments, which are applicable to reactor vessels as well as other components, and thinner section weldments, which are applicable to piping. Major portions of both the heavy-section and piping weldment studies are concerned with the development and evaluation (including the determination of elevated-temperature design data) of improved filler metals that contain controlled additions of minor elements for increased strength and ductility. A limited effort is continuing to gain fundamental information on the welding of materials such as Incoloy 800, austenitic stainless steels, and ferritic steels that are used in critical nuclear components. The major concern with the first two materials is their propensity to microfissure, while both hot- and cold-cracking have been problems with the ferritic steels. (auth)

11220 (RDT-F-6-6-T(6-73)) WELDING OF STRUCTURAL COMPONENTS (AWS D1.1 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jun 1973. 9p. RSO.

A standard prescribing requirements for welding of structural components (AWS D1.1 with additional requirements) for nuclear and associated applications is presented. (JRD)

11221 (TRG-Report-2267) PREDICTION OF THE YIELD STRENGTH ON ISOTHERMAL AGEING OF THE PRECIPITATION-HARDENING ALLOY NIMONIC PE16. Smith, K. B. (United Kingdom Atomic Energy Authority, Springfields (England). Reactor Group). Feb 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50. UK 50 pence.

An investigation has been made of the precipitate-particle strengthening effects in the precipitation hardening alloy Nimonic PE16. By considering the mechanism of precipitate-particle strengthening and the variation of the relevant parameters with temperature, general relationships have been established that successfully predict the effect of isothermal aging, in the temperature range 600 to 825°C on the incremental precipitate yield strength. An empirically derived relationship describes the response to isothermal aging in the region of increasing strength with time and one based on the Orowan theory predicts the decrease in strength with time beyond peak strength. The existence of a transition region between the two types of strengthening resolves the apparent discrepancies implied by some of the earlier experimental data and the good agreement with experiment gives confidence in long-term extrapolation. (auth)

11222 PREPARATION OF SINGLE CRYSTALS OF In-Tl ALLOYS. Murtha, M. J.; Jensen, H. J.; Burnet, G. (Ames Lab., IA). J. Cryst. Growth; 19: No. 1, 58-60(Apr 1973).

A modified Bridgman method was developed for the growth of large (1.9 cm dia by 10 cm long) single crystals of In-Tl alloys containing up to 30 at % thallium. Highly homogeneous, strain-free crystals of both the face-centered tetragonal and the face-centered-cubic lattice structures were produced, using the method. A lava crucible was used to reduce mechanical strain. The crucible was enclosed in a stainless steel container under positive inert gas pressure that limited oxidation and vaporization of the alloys. (auth)

11223 INFLUENCE OF PHYSIOCHEMICAL FACTORS ON WETTING OF ALUMINUM ALLOYS BY EASILY FUSIBLE SOLDERS UNDER ACTION OF ULTRASOUND. Alieva, M. P.; Glikman, E. E.; Goryunov, Yu. V.; Ermolov, V. A.; Pertsov, N. V.; Polyakov, Yu. A. Fiz. Khim. Obrab. Mater.; No. 1, 130-136(1973). (In Russian).

During ultrasound plating of Al with low-melting solders (Wood's metal type), the complete wetting of the Al was observed only when the bath was heated to a given temperature. The introduction of certain metals such as Zn was successful in lowering the bath temperature. Experimental additions of Zn, Li, Ga, Ge, Pb, In to the Wood's metal (Bi-25% Pb-12.5% Sn-12.5% Cd) were tested, as well as the binary alloy Bi-40% Cd. (KSW)

11224 PURIFICATION OF YTTRIUM BY ELECTROREFINING. Fleck, D. C.; Kleespies, E. K.; Kesterke, D. G. Rep. Invest. No. 7719. Washington, DC; Bureau of Mines (1973). 12p.

Electrorefining Y from selected low-melting Y-base alloys was investigated and various halide systems studied as potential electrolytes for use in preparing low-O Y by electrorefining unalloyed Y. Yttrium cathode products having significantly less metallic impurities than the anode materials were prepared from alloys containing Ni, Fe, and Mn by electrorefining LiCl-YCl_3 electrolytes at 900 to 1000°C. Yttrium-Cu and Y-Mg alloys are not suitable as anode feed materials. An evaluation of chloride, fluoride, bromide, and mixed chloride fluoride electrolytes showed that cathode products containing much less O than the anode material can be obtained in the fluoride and mixed chloride-fluoride systems. Initial cathode current density has no apparent effect on the purity of the products obtained in both phases of the investigation. (Metals Abstr.)

Properties, Structure, and Phase Studies

Refer also to abstracts 11132, 11140, 11161, 11189, 11789, 12558, and 12559.

11225 (COO-841-27) THERMOTRANSPORT OF BERYLLIUM AND MERCURY IN LIQUID SODIUM. Bhat, B. N.; Murarka, S. P.; Swalin, R. A. (Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science). 1972. Contract AT(11-1)-841. 6p. Dep. NTIS $3.00.

The thermotransport of trace amounts of beryllium and mercury in liquid sodium was determined. Appropriate alloys were prepared by mixing pure liquid sodium metal with appropriate amounts of radioisotopes of ^{7}Be and ^{203}Hg. The samples were held in a known temperature gradient for a sufficiently long time for the stationary state to be attained. The resulting segregation is related to the temperature gradient through a quantity Q^*, the heat of transport. A comparison was made between the behavior of the light Be solute and the heavy solute Hg. (JCW)

11226 (JAPFNR-103) HIGH-SPEED TENSILE TEST AT THE ELEVATED TEMPERATURES. Fujimura, T.; Isozaki, T.; Oba, T. (Japan Atomic Energy Research Inst., Tokai). May 1972. 50p. (PNC-J-250; JAERI-Memo-4854). Dep. NTIS (U. S. Sales Only) $4.75.

For Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan.

The effects of strain rate on the mechanical properties of stainless steel, SUS 27 at room temperature and 400°C are reported using a high speed tensile machine. In these experiments, each explosive amount of 1, 2, 5, and 10 g was used to vary the strain rate. A new apparatus was designed and used to measure the elongation of the specimen under high velocity. Conclusions show that the ultimate strength of SUS 27 increases with increasing strain rate at the temperatures of room temperature and 400°C, but it seems to remain constant at 600°C. The ratio of the ultimate strength under the high velocity tensile test to the static tensile test is also obtained. The total elongation and the reduction of area remain constant at all testing temperatures. (auth)

11227 (N-73-13736) STUDY OF BERYLLIUM AND BERYLLIUM-LITHIUM COMPLEXES IN SINGLE-CRYSTAL SILICON. Crouch, R. K.; Robertson, J. B.; Gilmer, T. E. Jr. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Dec 1972. 31p. NTIS.

When beryllium is thermally diffused into silicon, it gives rise to acceptor levels 191 and 145 meV above the valence band. Quenching and annealing studies indicate that the 145-meV level is due to a more complex beryllium configuration than the 191-meV level. When lithium is thermally diffused into a beryllium-doped silicon sample, it produces two acceptor levels at 106 and 81 meV. Quenching and annealing studies indicate that these levels are due to lithium forming a complex with the defects responsible for the 191- and 145-meV beryllium levels, respectively. Electrical measurements imply that the lithium impurity ions are physically close to the beryllium impurity atoms. The ground state of the 106-meV beryllium level is split into two levels, presumably by internal strains. Tentative models are proposed. (auth)

11228 (NAA-SR-6732) MECHANICAL STRENGTH OF HYDRIDES OF ZIRCONIUM AND ZIRCONIUM-BASE ALLOYS. Raymond, J. W.; Toy, S. M. (Atomics International, Canoga Park, Calif.). 15 Apr 1962. Contract AT(11-1)-GEN-8. 22p. Dep. NTIS $3.25.

Declassified 17 Apr 1973.

An investigation of mechanical properties of zirconium hydride and zirconium-base alloy hydrides was conducted to obtain fundamental information pertinent to basic reactor design. The study consisted of compressive strength and elevated temperature transverse rupture strength tests of zirconium hydride and zirconium-base alloy hydrides of compositions 2.2 wt % Nb, 3.9 wt % La, 1.4 wt % Cr, and 7 and 10 wt % U. Results indicated that alloying essentially doubled the transverse rupture strength of zirconium hydride of the same approximate hydrogen concentration, probably due to a grain refining effect of the hydride. The data showed that none of the alloy additions imparted a strengthening effect significantly greater than that of the uranium addition. Results obtained from elevated temperature transverse rupture tests conducted on the 10 wt % U alloy hydride showed that the rupture strength increases with increasing temperature (at least, up to approximately 1000°F), and with increased hydrogen concentration beyond the composition ~1.75 hydrogen atom/metal atom. A significant increase in compressive strength of zirconium hydride was found to result from all alloy additions studied. (auth)

11229 (NAA-SR-7305) DEVELOPMENT OF A HIGH YIELD 90 Zr–10 U ALLOY MASSIVE HYDRIDE. Raymond, J. W. (Atomics International, Canoga Park, Calif.). 1 Jan 1963. Contract AT(11-1)-Gen-8. .22p. Dep. NTIS $3.25.

Declassified 24 May 1973.

Through addition of approximately 0.4 wt. % carbon (as zirconium carbide) to a 90 wt. % Zr–10 wt. % U alloy, a 100% yield of uncracked massively hydrided fuel elements of high hydrogen density (N_H = 5.7 to 6.6) was obtained. The marked increase in yield was attributed to the presence of a carbide phase, serving as a nucleant and grain-growth inhibitor during solidification and subsequent solid-state transformations that occur during the hydriding process. The resulting hydride structure was fine grained and equiaxed. (auth)

11230 (NAA-SR-9525(Vol.2)) BIBLIOGRAPHICAL SURVEY OF SNAP FUEL MATERIALS ZIRCONIUM–URANIUM HYDRIDE AND RELATED ZIRCONIUM AND URANIUM SYSTEMS. Barsell, A. W.; Montgomery, L. D.; Roberts, J. T. (Atomics International, Canoga Park, Calif.). 26 Jun 1964. Contract AT(11-1)-GEN-8. 100p. Dep. NTIS $7.00.

Declassified Oct 1972.

A review is presented of investigations of every nature that have been conducted on the zirconium–hydrogen and the zirconium–uranium–hydrogen systems. In addition, report numbers of unclassified publications on the individual metals—zirconium, uranium, zirconium–uranium alloys, the oxides of these metals and alloys, and uranium hydride—are included without abstracts. Volume II consists entirely of abstracts of publications concerning zirconium hydride and zirconium–uranium hydride. These abstracts are listed according to author and are assigned, in order, a reference number (beginning with 1.) prefixed by the volume number. All reference numbers prefixed with I appear in Volume I and those prefixed with II appear in Volume II. This identification system has made possible common subject, report, and author indexes for both volumes of zirconium-hydride and zirconium uranium-hydride abstracts. These common subject, report, and author indexes appear identically in both volumes so that each volume may stand on its own. (JRD)

11231 (NAA-SR-9704) MICROSTRUCTURE STUDIES OF SNAP FUELS. Taketani, H. (Atomics International, Canoga Park, Calif.). 30 Mar 1965. Contract AT(11-1)-Gen-8. 27p. Dep. NTIS $3.50.

Declassified 17 Apr 1973.

The microstructure of SNAP fuel was examined in detail using various microstructural techniques (e.g., quantitative metallography, electron microscopy, chemical separation and coalition, x-ray diffraction, and electron microprobe analysis). The microstructure was found to consist of two precipitate phases within a matrix of ϵ hydride. (auth)

11232 (NAA-SR-9782) THERMOPHYSICAL PROPERTIES OF SNAP FUELS. Taylor, R. E.; Ambrose, C. J. (Atomics International, Canoga Park, Calif.). 26 Jun 1964. Contract AT(11-1)-GEN-8. 41p. Dep. NTIS $4.25.

Declassified 17 Apr 1973.

The specific heat, thermal diffusivity, thermal conductivity, electrical resistivity, and thermal expansion of various zirconium–uranium hydrides were measured. The coefficient of thermal expansion was found to be 6.89×10^{-6} per °F from room temperature to 1400°F, which agreed with previous results from this laboratory. The specific heat results, which increased from 0.102 cal/g-°C at 400°K to 0.170 cal/g-°C at 850°K for Zr–10 wt % U alloy with an H/Zr ratio of 1.68, agreed within 8% of the results obtained using a simple theoretical model. Calculations of the specific heat based upon this model are within 8% of the experimental results obtained by numerous laboratories on a variety of compositions. Consequently, it is possible to calculate the specific heat as a function of composition and temperature, except near a phase change. The thermal conductivity of zirconium–uranium hydrides is markedly influenced by the composition but is nearly temperature independent. The formation of a hydrogen sublattice greatly increases the nonelectronic contribution to the thermal conductivity. (auth)

11233 (NAA-SR-10277) ROOM-TEMPERATURE COMPRESSIVE PROPERTIES OF Zr—10 U ALLOY HYDRIDE AT HIGH HYDROGEN CONTENTS. Lundberg, L. B.; Berling, J. T. (Atomics International, Canoga Park, Calif.). 30 Aug 1966. Contract AT(11-1)-GEN-8. 47p. Dep. NTIS $4.50.

Declassified 17 Apr 1973.

Room-temperature, short-term compressive tests and direct determinations of Poisson's ratio were performed on Zr–10 U alloy hydrides. The phenomenon of hydrogen loss on compression was also observed, and studied in some detail. Results of room-temperature compression tests on the fuel, prepared by both standard production and precipitation hydriding techniques, have indicated that carbon content also has a significant effect on the ultimate strength and ductility. Microdefects in the fuel, possibly resulting from the hydriding process, were seen to have an effect on the Young's modulus and the directly measured Poisson's ratio. Microcracks found in the precipitation-hydrided material caused higher moduli and Poisson's ratios. Microcracks created during plastic deformation also caused an increase in the Young's modulus of the fuel. This phenomenon was attributed to twin-boundary pinning. A discovery during the study was the release of hydrogen, as a result of room-temperature compressive testing. The amount of hydrogen released seems to be a function of strain rate, hydride phase, and grain structure. The highest release observed in this preliminary study was the order of 0.02 to 0.03 wt% hydrogen. The mechanism of hydrogen release in the elastic region for ϵ-hydride fuel is postulated as follows: since ϵ-hydride material strains by twin interface motion under applied stress, and since this interface is composed of edge and screw type dislocations, it is conceivable that uncombined hydrogen in these twinning dislocations will emerge from dislocations which cut the surface of the sample. The mechanism for hydrogen release in the inelastic region is postulated to be a short-circuiting mechanism, in which hydrogen gas is dragged along with dislocations and released at numerous micro- and macrocracks formed during inelastic straining. (auth)

11234 (NAA-SR-10965) PHASE RELATIONSHIPS AND MICROSTRUCTURES IN THE ZIRCONIUM—10 Wt Percent Uranium Alloy Hydride System. Raymond, J. W. (Atomics International, Canoga Park, Calif.). 30 Nov 1965. Contract AT(11-1)-GEN-8. 37p. Dep. NTIS $4.00.

Declassified 20 Jun 1973.

A microstructural survey was conducted in the zirconium–10 wt% uranium–hydrogen ternary system over the composition range (expressed in atom ratio) H/Zr = 0 to H/Zr = 2. Structures were prepared under both equilibrium and nonequilibrium conditions. A series of photomicrographs, demonstrating phase relationships and microstructures in the system, are presented; and a revision to the Zr–H binary phase diagram is proposed. (auth)

11235 (NAA-SR-11316) EFFECTS OF PROCESSING AND OPERATING PARAMETERS ON THE CREEP PROPERTIES OF SNAP REACTOR FUEL ELEMENT CLADDING. Culley, G. E.; Berling, J. T. (Atomics International, Canoga Park, Calif.). 15 Oct 1965. Contract AT(11-1)-GEN-8. 32p. Dep. NTIS $3.75.

Declassified 17 Apr 1973.

A series of 1,000-h biaxial creep tests at 1400°F were performed on SNAP 8 reactor fuel element cladding to determine the influence of the processing and operating parameters (excluding radiation) on the creep characteristics of the cladding. The parameters tested include those associated with variations in ceramic hydrogen barrier coatings, grain size, hydrogen permeation, stress level, and flowing NaK. The tests were conducted over a range of hoop stresses from 2,500 to 12,000 psi and the resulting creep data were compared with INOR-8 data obtained in air and molten salt. The general conclusion for these accelerated tests was that the SNAP 8 reactor parameters caused no gross effects upon the creep properties of the cladding material. However, trends for certain parameters were detectable (particularly at lower stress levels), and may be important considerations in long-term creep. (auth)

11236 (NAA-SR-11960) MEASUREMENT OF THERMAL PROPERTIES OF SNAP FUEL MATERIALS. Vetrano, J. B.; Ambrose, C. J.; Culley, G. E.; Finch, F. A.; Nakata, M. M.; Deem, H. W.; Eldridge, E. A.; Foster, E. L.; Lagedrost, J. F.; Matolich, J.; Nelson, S. G. (Atomics International, Canoga Park, Calif.). 20 Jun 1967. Contract AT(04-3)-701. 72p. Dep. NTIS $5.75.

Declassified 24 May 1973.

Because of the existing conflicting information on the thermophysical properties of zirconium hydride, two laboratories worked in close cooperation to develop highly reliable data on the uranium-bearing zirconium hydride and on the unhydrided alloy. Measurements of specific heat and thermal diffusivity were made on both hydrided and unhydrided compositions, and the thermal conductivity was calculated from the product of these quantities and the density of the material. Because of thermal gradients that cause hydrogen redistribution, only the unhydrided composition was subjected to a direct steady-state measurement of the thermal conductivity. Agreement between experimental and calculated values proved to be good. (auth)

11237 (NAA-SR-12025) HYDROGEN BEHAVIOR IN NaK-78. Webb, R. W. (Atomics International, Canoga Park, Calif.). 1 May 1967. Contract AT(04-3)-701. 38p. Dep. NTIS $4.00.

Declassified 31 Oct 1972.

Pressure-temperature isochores were obtained for NaK-hydrogen solutions, spanning the composition range of 0.5 to 25 ppM

hydrogen. The studies were confined to a temperature range of 1075 to 1320°F and a hydrogen pressure range of 2 to 400 microns. An expression equating equilibrium dissociation pressure to temperature and composition was determined, as was the heat of solution function over the range of compositions studied. Hydrogen permeability of Type 321 stainless steel containment vessels was also studied as a function of hydrogen concentration in NaK and the equilibrium hydrogen dissociation pressure. An expression equating these parameters was established. Based on the results of this study, the concept of using a hydrogen getter (i.e., yttrium) in the liquid coolant channels of SNAP reactor systems appears feasible. Each reactor system, however, is a separate case of study, since the surface area for hydrogen permeation out of the system is the most critical factor in establishing ultimate hydrogen concentration levels in the liquid metal coolant. (auth)

11238 (NAA-SR-12607) THERMOPHYSICAL PROPERTIES OF UNIRRADIATED SNAP FUELS. Young, W. A.; Weeks, C. C.; Nakata, M. M.; Smith, C. A. (Atomics International, Canoga Park, Calif.). 23 Feb 1968. Contract AT(04-3)-701. 62p. Dep. NTIS $5.25.

Declassified 24 May 1973.

Enthalpy and thermal diffusivity measurements were made on four SNAP fuels from room temperature to 900°C. The specific heats were determined from the enthalpy measurements, and thermal conductivities were calculated from the product of specific heat, thermal diffusivity, and density. Polynomial expressions were obtained for the evaluation of each of the properties as a function of temperature. The fuels investigated were zirconium 10 wt % uranium alloys, hydrided to ratios of 1.58, 1.65, 1.70, and 1.81 H/Zr. (auth)

11239 (NAA-SR-Memo-10536) ATOMICS INTERNATIONAL CONTRIBUTION TO 19th HIGH TEMPERATURE FUELS COMMITTEE. Preliminary Information, Section II. (Atomics International, Canoga Park, Calif.). 15 Oct 1964. 19p. Dep. NTIS $3.00.

Declassified 17 Apr 1973.

Values for the elastic modulus of SNAP fuel materials were obtained together with creep data for a range of carbon and hydrogen compositions. The existence of a discontinuity in the elastic modulus vs hydrogen composition curve was observed and appears to be associated with the delta-epsilon phase transformation. The existence of a ternary zirconium-carbon-hydrogen compound in SNAP fuel materials was confirmed. Results obtained in low-temperature fuel irradiation studies of SNAP fuels are reported. Density decreases substantially larger than predicted were observed. The results obtained from hydrogen permeation barrier materials irradiation tests show no large effect of irradiation on the in-pile hydrogen permeation rates. (auth)

11240 (NRL-7565) J-INTEGRAL CHARACTERIZATION OF IRRADIATED STAINLESS STEELS. Loss, F. J.; Gray, R. A. Jr. (Naval Research Lab., Washington, D. C.). 25 Apr 1973. 26p. Dep. NTIS $3.50.

The J-integral is being investigated as a method of characterizing the elastic–plastic toughness level of structural materials used in advanced fast reactors. J is defined in an introductory sense, and several approximate methods for its evaluation on the basis of a single specimen test are high-lighted. Initial J evaluations are presented for irradiated 304 stainless steel in the annealed and cold-worked conditions and for 308 stainless steel weld deposit. Results indicate that cold-worked materials exhibit a significantly lower toughness than the annealed material in both irradiated and unirradiated conditions. Radiation significantly degrades the toughness of the annealed material while showing relatively little effect on the cold-worked specimens. The toughness of the unirradiated weld deposit is shown to be significantly less than that of the unirradiated plate. Finally, practical difficulties relating to a meaningful interpretation of the observed behavior are discussed as areas where current research efforts should be directed. (auth)

11241 (ORNL-TM-4055, pp 4.1-4.11) MECHANICAL PROPERTIES OF STRUCTURAL MATERIALS. Jan 1973.

In fuels and materials development program quarterly progress report.

The minimum yield strength of several heats of type 304 stainless steel are below the minimum values represented in ASME Code Case 1331-5 when those properties are determined at elevated temperatures for fully annealed material. The fully annealed condition represents material that has been reannealed at ORNL after specimen preparation. Yield-strength values obtained for the same heats in the as-received condition are above the minimum values in the ASME Code Case 1331-5. Creep tests at 1100°F are in progress up to approximately 7000 h in the as-received and annealed conditions. The variations between heats is less pronounced when the tests are performed at relatively low stresses. (auth)

11242 (ORNL–4854) SURFACE MIGRATION OF OXIDES ON SODIUM CHLORIDE SUBSTRATES. Annis, B. K. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 37p. Dep. NTIS $4.00.

The surface migration of radioactive species is a matter of some concern in connection with the salt mine radioactive waste repository concept. Consequently, an experimental study of the behavior of lanthanum and strontium oxides was carried out. The behavior of strontium oxide of course was of intrinsic interest, whereas the lanthanum oxide was employed to simulate plutonium. The investigation indicated that the surface migration of La_2O_3 at 693°K was well characterized by a diffusion coefficient of 3×10^{-10} cm²/sec. The behavior of SrO proved somewhat ambiguous, but at 583°K the surface diffusion coefficient appeared to be less than 3×10^{-12} cm²/sec. (23 references) (auth)

11243 (ORNL-TM-4155) EVALUATION OF DISCONTINUITIES IN HSST TWELVE-INCH-THICK PLATE. Klindt, K. K.; Canonico, D. A. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 38p. (CONF-690437-1). Dep. NTIS $4.00.

From 7th symposium on nondestructive evaluation of components and materials in aerospace, Weapons Systems and Nuclear Applications; San Antonio, Texas, USA (23 Apr 1969).

The Heavy Section Steel Technology Program has provided an opportunity to correlate results of nondestructive examination with these obtained in destructive investigations. A number of twelve-inch-thick steel plates were purchased with requirements for complete characterization of the plates. During the ultrasonic testing of plate 01 a number of large discontinuities were found. Areas containing these were cut out and an extensive investigation was conducted. During the ultrasonic investigation the effects of transducer size, frequency, and material thickness were studied. Discontinuities were mapped showing the effect of parameter changes. Other nondestructive methods were also used to describe the flaws. The sections were then destructively investigated to disclose many lamellar type voids with a thickness as great as ½ inch filled with foreign inclusions. The foreign material was rich in Si, Mn, Al, and Fe. An electron beam microprobe was also used to conduct microstructural studies of the inclusions and surrounding base metal. (auth)

11244 (RD/B/M-2588) CREEP STRESS EXPONENT FOR SOME REACTOR STRUCTURAL STEELS. Marshall, P. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Feb 1973. 14p. Dep. NTIS (U.S. Sales Only) $3.00.

Relative creep rates of different parts of components subjected to different stresses are critically dependent upon "n," the slope of the log strain rate/log stress graph. Values of n for several reactor structural steels are derived from creep deformation and rupture data. Typical n values are in the range 5 to 9 at high stresses and 2 to 5 at low stresses. (auth)

11245 (UCRL-74697) DEVELOPMENT OF MATERIALS FOR ENERGY RELATED APPLICATIONS. Kane, J. S. (California Univ., Livermore. Lawrence Livermore Lab.). 10 Apr 1973. 16p. (CONF-730416-2). Dep. NTIS $3.00.

From 2nd Cairo solid state conference; Cairo, United Arab Republic (21 Apr 1973).

The application of materials science and technology to develop new energy sources and to make current energy systems more efficient is discussed. The energy sources discussed include solar energy, thermonuclear energy, and fossil fuel energy. Energy conversion techniques discussed include thermal cycles, solar photovoltaic, thermal decomposition of water, and hydrogen-air fuel cells. The methods for energy transmission that are outlined are hydrogen pipelines and superconducting or cryogenic electrical transmission lines. Transportation optimization and efficiency are dealt with in the light of those components yielding the largest benefit for the overall system. (JCW)

11246 STUDY OF THE EUROPIUM–OXYGEN SYSTEM BY A DIELECTRIC METHOD. Bideau, D.; Grosvald, G.; Padiou, J. (Univ., Rennes, France). Phys. Lett.; 44A: No. 2, 87-88 (21 May 1973). (In French).

Results were previously given of a dielectric study of europium oxides in the composition range Eu_3O_4–Eu_2O_3. This note is devoted to an extension of this study to the whole system EuO–Eu_2O_3. An attempt is made to find the phase responsible of the observed phenomena. (tr-auth)

11247 FERROMAGNETISM IN DILUTE TERNARY Pd(Fe,Gd) ALLOYS. Crangle, J. (Univ. of Sheffield, Eng.). Phys. Lett.; 44A: No. 2, 77-78(21 May 1973).

In $(Pd_{0.997}Fe_{0.003})_{1-x}Gd_x$ alloys the apparent magnetic moment of the polarized palladium solvent falls sharply with increasing x, and changes sign. The Curie temperature goes through a broad minimum at $x \approx 0.02$. (auth)

11248 REDISTRIBUTION OF Ta AND W IMPURITIES IN NIOBIUM BY ELECTRON-BEAM FLOAT-ZONE REFINING. Reed, R. E. (Oak Ridge National Lab., TN). J. Cryst. Growth; 19: No. 1, 61-64(Apr 1973).

Niobium rods, 12.5 mm in diameter and with about 0.05 wt. % each of Ta and W impurities, were electron-beam float-zone refined one pass at zoning speeds from 1.4×10^{-4} to 10×10^{-2} cm/sec. Autoradiography and neutron activation analyses were used to examine the redistribution of the Ta and W impurities along the rod. The Burton–Prim–Slichter (BPS) relationship between the effective distribution coefficients and the zoning speed was used for the data analysis. The equilibrium distribution coefficients were found to be 1.17 and 1.40 for Ta and W, respectively. Both impurities had a striated distribution parallel to the former liquid–solid interface along the zone length. Turbulent convection in the liquid, due to steep temperature gradients, was probably responsible for the striations and the good mixing in the liquid that was indicated by the BPS analysis. However, the redistribution of Ta and W at zoning speeds slow enough for the effective distribution coefficient to approach the equilibrium value was opposed by an enrichment due to preferential evaporation of the niobium. (auth)

11249 PARAMAGNETIC SUSCEPTIBILITY OF $SmZn_{12}$. Stewart, A. M. (Univ., Genoa). J. Phys., F (London); 3: No. 5, 1024-1030(May 1973).

The polycrystalline paramagnetic susceptibility of the intermetallic compound $SmZn_{12}$ is found to obey a quasi Curie–Weiss law in the temperature range 45 to 270°K, in agreement with a recently proposed theory. The parameters obtained from the experimental fit are in good agreement with those obtained from the susceptibilities of other RZn_{12} compounds, where R is a rare earth. It is suggested that previously published arguments, which assert that s–f mixing plays an important part in some gadolinium compounds, are invalid. (auth)

11250 ELECTROTRANSPORT OF SODIUM IN LIQUID POTASSIUM METAL. Roxbergh, C.; Persson, T.; Lodding, A. (Chalmers Tekniska hoegskola, Goteborg). Phys. Chem. Liquids; 4: No. 1, 1-13(Jan 1973).

The electromigration of ^{22}Na was studied in liquid Na-K of two compositions, about 1% and 11% Na. For the low Na alloy the effective charge number Z^*_{exp} (of tracer motion relative to container) ranges from about −12 at the melting point to −5.5 at 300°C, and for 11% Na from −3.5 at the melting point to −2.5 at 150°C. The migration velocity, obtained by a method free from convective disturbances, is found to be by an order of magnitude higher than that quoted in one earlier investigation, and by some 50% higher than another set of data. Theoretical arguments, connecting Z^*_{exp} with the resistivity increment per impurity atom, are well borne out by the present results, and also predict the change of sign observed at higher Na concentrations. (auth)

11251 ELECTRICAL RESISTIVITY OF VOIDS. Martin, J. W.; Paetsch, R. (Danmarks Tekniske Hoejskole, Lyngby, Denmark). J. Phys., F (London); 3: No. 5, 907-915(May 1973).

The electrical resistivity of spherical clusters of vacancies (voids) in the simple metals sodium, magnesium, and aluminium was calculated by two different methods, one based on phase-shift scattering and the other on pseudopotentials. In the phase-shift method the clusters were represented by a spherical potential well, whose radius was adjusted to give a volume equal to that of the vacancies in the cluster and whose depth was determined so as to satisfy the Friedel sum rule for the phase shifts. In the other method, local screened pseudopotentials, situated at the vacant lattice sites, were used and the cross section of the cluster was determined from perturbation theory. The clusters contained from 1 to 89 vacancies in as spherical a packing as possible. In the pseudopotential model the resistivity $\rho(N)$ of a cluster of N vacancies increased smoothly with increasing N and a power law relation $\rho(N) \propto N^{\alpha}$ held, with values of α from 0.79 to 0.96 for the three metals. In the phase-shift calculations a similar power law was also found, this time with all values of α close to 0.73. The absolute values of the resistivity found by the two methods were in close agreement for magnesium and aluminium, though there was a substantial discrepancy in the case of sodium. Similar calculations for spherical interstitial clusters were also performed, although such clusters have not been observed experimentally. The results have the same general features as for the voids. (auth)

11252 MECHANICAL HYSTERESIS IN BERYLLIUM SINGLE CRYSTALS ORIENTED FOR (1010) [1120] SLIP. Turner, G. I.; White, J. S. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Phys., F (London); 3: No. 5, 926-932(May 1973).

The temperature dependence of the friction stress for $(10\bar{1}0)\langle 11\bar{2}0\rangle$ type dislocations in beryllium was measured in the range 300 to 500 K. For each temperature investigated, the friction stress was computed from the maximum loop width and the corresponding irreversible work data, obtained from the family of closed hysteresis loops developed by the cyclic compression of appropriately oriented single crystals. In addition, the values were also determined using the alternative method involving the elastic limit as obtained by extrapolation of the maximum shear stress against the maximum loop width curve to zero loop width. Both methods of analysis give essentially the same results. The data show that the friction stress for this system decreases in an almost linear fashion with increasing temperature from 0.28 kg mm^{-2} at 300 K to 0.13 kg mm^{-2} at 500 K. In magnitude, these values are approximately five times the corresponding values previously reported for $(0001)\langle 11\bar{2}0\rangle$ type dislocations in beryllium. (auth)

11253 INVESTIGATION OF THE ABNORMAL SNOEK PEAK IN THE IRON-VANADIUM-NITROGEN SYSTEM. Welch, W. D. Jr. (Hastings Coll.,NE); Carpenter, S. H. Acta Met.; 21: No. 8, 1169-1179(Aug 1973).

An experimental investigation of the anelastic behavior of the Fe–V–N alloy system was conducted to explain the occurrence of the additional internal friction (abnormal) peak which is observed when vanadium is added to the Fe–N system. Internal friction and stress relaxation experiments were performed in an inverted torsional pendulum and the effects of both vanadium and nitrogen concentration on the abnormal peak were examined. A curve fitting procedure was used to fit the abnormal peak with Debye peaks. The proposed defect model is consistent with the experimental and theoretical results and involves a nitrogen atom bound in a first-neighbor tetrahedral position about the substitutional vanadium atom. The abnormal peak is thought to be due to interstitial nitrogen diffusion about the VN defect. (auth)

11254 DISTRIBUTION OF CARBIDE PHASES IN AGING NIOBIUM ALLOYS FROM ELECTRON-MICROSCOPE STUDY. Ivanova, K. N.; Naletov, A. M.; Savitskii, E. M.; Ignatov, D. V. Fiz. Khim. Obrab. Mater.; No. 1, 106-111(1973). (In Russian).

Nb alloys containing 5% W, 5% Mo, 1% Zr, and ≤ 0.1 wt % C were fused by arc melting in a vacuum and aged at several temperatures (1000 to 1750°C). The electron microscope revealed the presence of inclusions of Nb_2C, (Zr, Nb)C and various structural changes as a result of aging. The phase (Zr, Nb)C plays a fundamental role in toughening these alloys. (KSW)

11255 NITRIDING OF MARTENSITE-AGED STEEL. Lakhtin, Yu. M.; Tsyrlin, E. S. Fiz. Khim. Obrab. Mater.; No. 1, 101-105 (1973). (In Russian).

The kinetics of nitriding a martensite steel containing 18.5% Ni, and 5.1% Mo was studied at 450, 500, and 560°C. The effects of nitriding on the alloy's microhardness, impact ductility, and corrosion resistance to H_2S, salt mist, and 97% relative humidity were studied; nitriding did not effect significant changes in most characteristics. (KSW)

11256 ABSORPTION OF NITROGEN BY NIOBIUM FROM AN ARC PLASMA. Erokhin, A. A.; Pankratov, N. N.; Pugin, A. I.; Moiseev, V. F.; Ban'kovskii, O. I. Fiz. Khim. Obrab. Mater.; No. 1, 15-20(1973). (In Russian).

The absorption of N by Nb from the gaseous phase during plasma-arc melting was investigated. The rate of N absorption increased with a rise in the partial pressure of N. Equilibrium conditions for the Nb–N system in the presence of a N-containing arc were established, and the effective coefficient of mass transfer of N was determined. An equation was proposed which described the effect of the partial pressure and the rate of fusion on the N content in the ingot during the quasi-steady state process. (tr-auth)

11257 APPLICATIONS AND POTENTIAL OF THE MOESSBAUER METHOD AS AN INVESTIGATORY TOOL IN METALLURGY AND MATERIALS ENGINEERING. Ron, M. (Israel Inst. of Tech., Haifa). pp 493-531 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720694-.

In reviewing the uses of the Mössbauer method for investigations in metallurgy and materials engineering, the author, after outlining (section 1) the physical background, surveys the subject under the following headings: (section 2) transmission Mössbauer spectroscopy in physical metallurgy; (2.1) analysis of substitutional alloys of iron; (2.2) identification of phases and atomic configurations in Fe–C, Fe–N systems; (2.3) phase transformations and kinetics of processes—iron in Ti–Fe alloy; precipitation studies in Fe–C, 17-7 PH stainless steel, Sn–invar, Fe–Mo; spinodal composition of Fe–Cr solid solution, Cu–Fe; (2.4) superparamagnetism; (2.5) magnetic anisotropy; (2.6) plastic deformation of stainless

steel; (2.7) stress measurements; (section 3) Mössbauer spectroscopy in backscattering geometry – determination of oxides and oxyhydroxide layers: conversion electrons: surface effects of Sn, Sn-Br: determination of retained austenite and other phases in steel: explosive deformation of stainless steel: multidomain structure-dependence on stress: potential uses and problems of backscattering Mössbauer experiments. (31 figures, 99 references) (auth).

11258 MOESSBAUER STUDY OF THE DISSOLUTION, BY PLASTIC DEFORMATION, OF METASTABLE GAMMA-IRON PRECIPITATES IN COPPER. Ron, M. (Israel Inst. of Tech., Haifa). pp 531-539 of Nuclear Techniques in the Basic Metal Industries. Vienna; International Atomic Energy Agency (1973).

From Symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972). See STI/PUB-314; CONF-720704-.

The Moessbauer effect has been utilized to study the precipitation of γ- and α-iron in copper as well as the transformation from metastable γ-iron to stable α-iron, by plastic deformation. In this investigation, the Mössbauer spectra of ^{57}Fe were used to study the reverse process of dissolution of metastable γ-iron precipitates by plastic deformation. The specimens were prepared by melting pure materials, enriched with ^{57}Fe, in a reducing atmosphere. They were rolled into foils and rapidly quenched into brine at 0°C, under a protecting atmosphere. It is shown that the relative area of the Mössbauer line, corresponding to γ-iron precipitates, diminishes on plastic deformation. No lines corresponding to α-iron appear, but the relative area of another line, located at approximately +0.23 mm · s^{-1} relative to α-iron, increases. This line had been related to iron atoms in solid solution without iron neighbours. A doublet appearing in the spectra of quenched alloys had been related to clusters consisting of two or more Fe atoms. Subsequent annealing restores the relative spectral area of the line representing the γ-iron precipitates. The conclusion may be drawn that iron atoms of the metastable γ-precipitates and iron atom clusters are re-dissolved into the copper matrix, on plastic deformation. The interpretation of the singlet at approximately +0.23 mm · s^{-1} relative to α-iron, which had been attributed only to those iron atoms without iron atom neighbours, is reviewed. The phase represented by this singlet is the only one which grows as a result of destruction of both the γ-iron precipitates and the clusters of iron atoms, by plastic deformation. It is unlikely that these iron atoms are perfectly dispersed so that the singlet cannot represent single, separated iron atoms alone. It is suggested that the shift in the position of this line as a result of rolling could be related to tensile stresses imposed on an iron atom in the vicinity of a dislocation. (auth)

11259 EFFECT OF PRESSURE ON FRICTION, WEARING, AND PROPERTIES OF TRANSITION METAL SURFACE. Samsonov, G. V.; Kovtun, V. I.; Bovkun, G. A. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 4, 87-92(Apr 1973). (In Russian).

Results are presented of an investigation of the pressure effect on friction force, wearing, and microhardness of Cr, Nb, W, Fe, and Ni surfaces with dry sliding friction of the same metals in vacuum (1.5 to 3) × 10^{-5} mm Hg. Friction force and wearing at definite pressures are shown to grow abruptly. Microhardness of the surfaces at first also increases and then decreases. The pressure at which microhardness begins decreasing evokes a still greater increase in the friction force and wearing values. Results are explained by a change in the electronic structure of the metals and in the type of bond in the surface layers and between atoms of the surfaces contacting during friction. The difference in the friction force of the investigated metals is explained from the same points of view. (auth)

11260 ROST KRISTALLOV. Tom IX. (Crystal growth. Volume IX. Conference Held at Leningrad, USSR, May 21-24, 1969). Sheftal, N. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). 296p. (CONF-690572-).

From symposium on crystal growth; Leningrad, USSR (21 May 1969).

The book includes 68 papers by various authors on the theory and practice of crystal growth from aqueous, salt, and metal solutions, and the hydrothermal and gaseous phases. Of especial interest here is the production of tetragonal K-W bronze, single crystals of InSb and GaSb, and the oxyboride NbOB. (KSW)

11261 INVESTIGATION OF POINT DEFECTS IN EQUILIBRIUM CONCENTRATIONS WITH PARTICULAR REFERENCE TO POSITRON ANNIHILATION TECHNIQUES. Seeger, A. (Max-Planck Institut fuer Metallforschung, Stuttgart). J. Phys., F (London); 3: No. 2, 248-294(Feb 1973).

After a comparison of the merits and weaknesses of equilibrium and nonequilibrium experiments, the investigation of monovacancies and divacancies in or near thermal equilibrium at high temperatures is reviewed. The use of positron annihilation for determining vacancy formation energies is covered in considerable detail and put into perspective relative to other methods (e.g., thermal expansion, self-diffusion, nuclear magnetic resonance.) The experimental techniques for studying the trapping of positrons at vacancies and the trapping model used for analyzing the experimental results are reviewed. A detailed discussion in terms of ion core size, valency, and valency relaxation is given of the trapping criteria for different metals. It is shown that the experimental results on the existence or nonexistence of positron trapping by vacancies are well accounted for by the theoretical ideas. It is further demonstrated that the $T^{-\frac{1}{2}}$ temperature dependence of the trapping cross section, following from the concept of thermalized positrons diffusing to the vacancy traps, is in good agreement with the available experimental data. The formation energies of monovacancies in metals obtained by the positron annihilation techniques are presented and compared with those obtained by other methods. (auth)

11262 STRESS RELAXATION IN THORIATED NICKEL ALLOYS. Arunachalam, V. S. (National Aeronautical Lab., Bangalore, IN); Lipsitt, H. A. Metallurgical Transactions; 4: No. 7, 1767-1768(Jul 1973).

Pure Ni, Ni-1.12% ThO_2, Ni-33.7% Cr-1.2% ThO_2, and Ni-21.3% Cr-2.42% ThO_2 were strained in an Instron tensile testing machine, with the machine being stopped at various stress levels and the stress being allowed to decay. The strain-rate sensitivity and the activation volume were determined. The influence of dislocation substructure was studied by means of cold rolling and annealing of the 33.7 Cr-1.2 ThO_2 composition. Pure Ni behaves as an ideal Cottrell-Stokes solid, but the dispersion-hardened alloys show a threshold stress σ_0 below which the strain rate sensitivity is zero. σ_0 is found to agree with the calculated Orowan stress (stress necessary for dislocation motion by forming loops around particles). (DLC)

11263 THERMOMECHANICAL EFFECTS ON HYDRIDE PRECIPITATION IN ZIRCALOY-2. Louthan, M. R. Jr.; Angerman, C. L.; (Savannah River Lab., Aiken, SC). Metallurgical Transactions; 4: No. 7, 1763-1765(Jul 1973).

Zircaloy-2 specimens with stepped gage sections were hydrided to ~40 ppM H_2 under tension at 400°C. The number and size of hydride platelets decreased with increasing tensile stress, and the H content increased slightly. Annealing at 400°C produced normal unstressed hydride morphologies. Unstressed tensile specimens without stepped sections were hydrided and tested. The hydride size decreased with increasing applied stress, and stress orientation of the hydrides was also noted at the higher stress levels. This combination of effects increased the yield strength but had negligible effect on ductility. (DLC)

11264 ATOMIC ORDERING AND STRUCTURAL TRANSFORMATION IN THE V-Co-Ni TERNARY ALLOYS. Liu, C. T. (Oak Ridge National Lab., TN). Metallurgical Transactions; 4: No. 7, 1743-1753(Jul 1973).

The transformation behavior of the close-packed ordered nine-layered hexagonal structure (κ phase) existing in the V-Co-Ni ternary alloys was investigated by various metallurgical methods. Both neutron and x-ray diffraction indicate that atomic ordering and structural transformation take place separately. The isothermal aging at subcritical temperatures resulted first in the formation of cubic long-range-ordered α' from the fcc α matrix and subsequently transformation of the α' to hexagonal κ. The α' to κ transformation proceeds by nucleation and growth; however, both mode and morphology of transition vary with reaction temperature. These observations have been discussed in terms of the temperature dependence of nucleation and growth processes. The structural transformation produces massive substructures, which harden the alloy substantially. (12 figures, 40 references) (auth)

11265 X-RAY EXAMINATION OF DEFORMATION IN β Ti-V ALLOYS. Ling, F.; Rack, H. J.; Starke, E. A. Jr. (Georgia Inst. of Tech., Atlanta). Metallurgical Transactions; 4: No. 7, 1671-1676(Jul 1973).

The mechanical behavior of beta Ti-V alloys was studied by x-ray-diffraction techniques. Single crystals of two orientations, containing 20 to 40 wt.% V, were cold rolled to varying degrees. Fourier analysis techniques were then used to determine the microstrain, particle size, and twin fault probability developed during deformation. The deformation textures of the deformed crystals were also examined and found to vary considerably with vanadium content. These results were correlated with the observed variations in deformation modes produced by changes in solute content and microstructure. (auth)

11266 COMBUSTION OF POROUS METAL SAMPLES IN NITROGEN. Merzhanov, A. G.; Borovinskaya, I. P.; Volodin, Yu. E. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 206: No. 4, 905-908(1 Oct 1972). (In Russian).

The mechanism of nitriding of refractory metals in N_2 at pressures of 5 to 100 atmospheres was conducted with ~1 × 1 cm cylinders of pressed powders (Zr, Ti, Nb, and Ta). Some nitriding curves were obtained by continuous weighing of the samples. Some fundamentals of the mechanism are outlined. (KSW)

11267 ELECTRON MICROSCOPY OBSERVATIONS ON THE CRYSTALLIZATION OF THIN FILMS OF TANTALUM OXIDE. Kotval, P. S.; DeWit, C. J. (Union Carbide Research Inst., Tarrytown, NY). pp 165-170 of Sintering and Related Phenomena. Kuczynski, G. C. (ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on sintering and related phenomena; Notre Dame, Indiana, USA (5 Jun 1972). See CONF-720647-.

The structure of Ta_2O_5 has been described previously in several different crystallographic forms with varying unit cell lattice parameters. Two aspects noted are that a number of the more recent identifications of the structure involve unit cells that are large in one dimension and there is a definite distinction between the structure ascertained for Ta_2O_5 in the form of anodic films and Ta_2O_5 in the form of bulk crystals. Crystal structure transformations of films of Ta_2O_5 produced by anodization of Ta were studied. Transmission electron microscopy results from amorphous films are presented, and the "shear structure" observed in the crystallized films is explained in the light of the crystal structure of bulk crystals. (JCW)

11268 SELF-DIFFUSION IN SINTERING OF NONSPHERICAL METALLIC PARTICLES. Lee, D. N. (Korea Inst. of Science and Tech., Seoul). pp 261-268 of Sintering and Related Phenomena. Kuczynski, G. C. (Ed.). New York; Plenum Publishing Corp. (1973).

From 3rd international conference on sintering and related phenomena; Notre Dame, Indiana, USA (5 Jun 1972). See CONF-720647--.

The formulas describing the progress of shrinkage of a powder compact were derived for the case of nonspherical particles. The formulas explain how the geometry of the particles affects sintering rates. The formulas can be used to evaluate the activation energy for volume diffusion of metal. New experimental results on shrinkage of tantalum powder compacts composed of powders with the various shapes were analyzed based on the formula. The activation energy for the volume diffusion of tantalum was evaluated to be approximately 80,000 cal per mole. (auth)

11269 FRACTOGRAPHY OF FIBER-REINFORCED METAL COMPOSITES. Jones, R. C. (Massachusetts Inst. of Tech., Cambridge). pp 29-34 of Advanced Materials: Composites and Carbon. Buckley, J. D. (Comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466--.

Scanning electron microscope examination of fracture surfaces of metal matrix composites has been found to be a very useful tool in interpreting micromechanical behavior. Detailed examination of the components and their interaction in situ is possible. Incomplete bonding and debonding during deformation at diffusion bond planes in the matrix metal have been found to be major problems in certain composite systems, particularly in cross-ply arrangements. Filament damage, fiber-matrix bonding, and details of matrix failure have also been examined and correlated with observed mechanical behavior. (auth)

11270 NEW TITANIUM ALLOY FOR FORMS AND WELDMENTS. Crossley, F. A. (Lockheed Missiles and Space Co., Palo Alto, CA); Van Orden, J. M. Metals Eng. Quart.; 13: No. 2, 55-61(May 1973).

Properties and characteristics of Transage 129 (Ti-2 Al-11 V-2 Sn-11 Zr) show it to have exceptional promise for saving fabrication costs through its good cold formability and weldability. It also has excellent promise for saving weight due to its high strength and exceptional resistance to high cycle fatigue. (auth)

11271 ELECTRON AND FIELD ION METALLOGRAPHY OF ZONES IN NITRIDED Fe-Mo ALLOYS. Driver, J. H. (Univ. of Newcastle-upon-Tyne, Eng.); Papazian, J. M. Acta Met.; 21: No. 8, 1139-1149(Aug 1973).

Constant-activity nitriding of Fe-1.7 and 3 at.% Mo alloys in the temperature range 500 to 600°C produces homogeneous precipitation of fine coherent disc-shaped zones on $\{001\}$ ferrite planes, giving rise to continuous streaking in $\langle 001\rangle_\alpha$ directions in the electron diffraction patterns and high hardness increments. Transmission electron microscopy shows that the mean zone size and number density increase gradually throughout the nitriding process to nitrogen saturation. An analysis of the coherency strain field images indicates that the zones are of interstitial character and produce elastic displacements of 0.3 to 0.9 Å normal to the habit plane. The zone thicknesses and structures were studied in greater detail by field ion microscopy (FIM). The field evaporation technique demonstrates that the zones have an apparent interplanar spacing of 2.7 ± 0.5 Å normal to the $\{001\}_\alpha$ habit plane and thicknesses of ≈6, 9, and 12 Å. The FIM and EM observations are interpreted on the basis that the zones have a body-centered tetragonal structure in which some Fe atoms are replaced by Mo atoms in a random manner and in which N atoms are partially or completely ordered on alternate $(002)_\alpha$ planes as in α'' $Fe_{16}N_2$. (auth)

11272 OBSERVATIONS OF FRACTURE SURFACES IN A ZIRCONIUM-OXYGEN ALLOY. James, W. B.; Davies, T. J. (Univ. of Manchester, Eng.). Journal of Nuclear Materials; 47: No. 2, 198-204(Jun 1973).

Electron microscopy of fracture of a zirconium-8.5 at. % oxygen alloy, broken by impact, showed striations in areas of transgranular failure. Studies were made of the fracture surfaces of the alloy at different stages of fabrication and after various heat-treatments. The most likely explanation of the configuration of striations is that they are a form of Wallner lines resulting from the interaction of a rapidly advancing crack front with shock waves generated during extremely fast fracture. (12 figures, 14 references) (auth)

11273 PHYSICAL PROPERTIES OF VANADIUM. Neimark, B. E.; Belyakova, P. E.; Brodskii, B. R.; Voronin, L. K.; Korytina, S. F.; Merkul'ev, A. N. Heat Transfer-Sov. Res.; 5: No. 2, 141-145(1973).

The measurements were made on specimens of V fused by electron beam from powder. Data on physical and thermal properties are tabulated and presented graphically. (JRD)

11274 MAGNETIC VISCOSITY OF $SmCo_5$. Hahn, A.; Paulus, M. (Ruhr-Univ. Bochum, West Ger.). Phys. Lett., A; 44A: No. 3, 219-220(4 Jun 1973).

The magnetic after-effect in Sm Co_5 was investigated. A logarithmic time dependence of the magnetization is observed indicating a broad distribution of relaxation times. (auth)

11275 THERMAL CONDUCTIVITY OF INDIUM IN THE SOILD AND LIQUID STATES. Pashayev, B. P.; Magomedov, A. M. A. Heat Transfer-Sov. Res.; 5: No. 2, 1-3(1973).

Data obtained in measurement of In thermal conductivity in the range 50 to 570°C are presented and discussed. The measurements were made in vacuum to prevent oxidation. Results are presented in temperature vs thermal conductivity curves. (JRD)

11276 THERMAL CONDUCTIVITY AND LORENTZ FUNCTION OF YTTERBIUM BETWEEN 90 AND 300K. Chuah, D. G. S.; Ratnalingam, R. (Univ. of Science of Malayasia, Penang). Phys. Lett., A; 44A; No. 3, 175-177(4 Jun 1973).

The thermal conductivity of polycrystalline ytterbium 90 and 300°K was found to increase with temperature. The additional contribution to the thermal conductivity is likely to be due to the bipolar term. (21 references) (auth)

11277 TRANSFORMATION AND AGE-HARDENING BEHAVIOR OF Zr-19 wt % Nb. Cheadle, B. A.; Aldridge, S. A. (Chalk River Nuclear Lab., Ont.). Journal of Nuclear Materials; 47: No. 2, 255-258(Jun 1973).

In order to study the metastable β phase in Zr-2.5% Nb-0.10% O alloys used in reactors, the isothermal transformation and age-hardening behavior of Zr-19 wt % Nb-0.12 wt % O was studied. After cooling from 1125°K, the microstructure contained big retained β grains with oriented needles which were shown not to be hydride. After aging at temperatures below 800°K, the β phase will harden due to the formation of small ω plates. At 575°K, the reaction is very slow; even after 10,000 h, the structure still consists of small ω plates in a matrix of enriched β phase. (DLC)

11278 SPECTRAL RADIATIVITY OF TUNGSTEN IN THE VISIBLE REGION OF THE SPECTRUM AT HIGH TEMPERATURES. Latev, L. N.; Chekhovskoi, V. Ya.; Shestakov, E. N. Heat Transfer-Sov. Res.; 5: No. 2, 55-59(1973).

A hollow electrically heated W specimen was used in the experiments. An opening in the side wall of the specimen served as a black-body model. The radiation of surface of the specimen and the opening was directed into the inlet slit of a monochromator by means of an optical system. The radiation receiver, an FEU-17A photomultiplier, was placed behind the outlet slit. A diagram of experimental apparatus is included. Results are presented in tables and curves. (JRD)

11279 COMMENTS ON THE BETA-TO-ALPHA PHASE TRANSFORMATION IN ZIRCALOY-4. Holt, R. A. (Chalk River Nuclear Labs., Ont.). Journal of Nuclear Materials; 47: No. 2, 262-264(Jun 1973).

Previous studies showed that two types of structures can form on cooling from the β-phase: (1) basketweave structure in material A and (2) parallel-plate structure in material B. Under certain conditions, material A develops a deteriorated basketweave structure intermediate between the two structures. Specimens of A and B were cooled from 1000 and 1050°C at various cooling rates, and the transformation behavior was studied in depth. Plate-width distributions were measured for the cooling rate of 5°C/s from 1000°C. Cooling of material B at 600°C/s results in a basketweave structure, probably owing to homogeneous nucleation. Implications for the mechanism are discussed. (DLC)

11280 POINT DEFECTS IN HIGHLY DEFORMED VANADIUM. Anand, M. S.; Pande, B. M.; Agarwala, R. P. (Bhabha Atomic Research Centre, Bombay). Phys. Status Solidi (a); 17: No. 1, 311-314(16 May 1973).

Isochronal annealing of highly deformed vanadium (99.99%) was carried out using a resistivity technique. The derivative plot shows a sharp peak at 170°C. The migration energy and the reaction order for this stage are 0.8 and 2 eV, respectively. On this basis, the annealing stage is attributed to intrinsic point defects, although the effect of impurities cannot be ruled out completely. (auth)

11281 ELECTRICAL RESISTIVITY OF BARIUM AND YTTRIUM AT HIGH PRESSURE. Moodenbaugh, A. R.; Fisk, Z. (Univ. of California, San Diego, La Jolla). Phys. Lett.; 43A: No. 6, 479-480(23 Apr 1973).

Electrical-resistivity data suggest that yttrium and barium become d-metals under pressure. This behavior correlates with the pressure-induced superconductivity. (auth)

11282 MEKHANICHESKIE SVOISTVA REDKIKH METALLOV. (Mechanical Properties of the Rare Metals). Sokolov, L. D. (ed.). Moscow; Izdatel'stvo Metallurgiya (1972). 289p.

Mechanical properties such as resistance to deformation, ductility characteristics, fatigue, creep, and protracted strength are summarized for the rare metals: most of the rare earth elements, Ti, Sc, Y, In, Ga, Sr, Ti, K, Nb, Ca, Mg, Au, Cd, Ag, and a few common metals: Fe, Ni, Sn, Pb, Cu, Co, Bi, Zn, and Al. Most of the data are presented in the form of graphs, illustrating the variables listed above as functions of temperature or other parameter. 551 references (KSW)

11283 CRYSTAL STRUCTURE OF Sm_2Co_{17}. Khan, Y.; Mueller. B. (Ruhr Inst., Bochum, Ger.). J. Less-Common Metals; 32: No. 1, 39-45(Jul 1973).

The crystal structure of the high-temperature phase of the intermetallic compound Sm_2Co_{17} has been reported to be isotypic with the Th_2Ni_{17} structure. Here it is shown that the structure of this phase, in fact, is of the $CaZn_5$-type with the lattice constants a = 4.85617 Å and c = 4.08133 Å. (auth)

11284 PREPARATION OF DISPERSIONS OF CARBIDES AND NITRIDES IN ALLOYS. Thibaudon, D.; Roubin, M.; Paris, R. A. (Univ., Lyon). J. Less-Common Metals; 32: No. 1, 47-56(Jul 1973). (In French).

Dispersions of refractory carbides and nitrides in binary and ternary alloys composed of Fe, Ni, Co, Mn, Cr, and in stainless steel, were prepared chemically from coprecipitated hydroxides. The matrix metal was generally a mixed crystal of different metals formed during the reaction. Phases obtained during the different thermal treatments (nitration, carburation, heating under hydrogen) were studied by x-ray diffraction. Physical studies (electron microscopy, hot pressing, porosity, etc.) were made on dispersions of VN and NbC in stainless steel. (auth)

11285 TEMPERATURE DEPENDENCE OF DEFORMATION FOR β-PHASE NIOBIUM–16 TO 40% ZIRCONIUM ALLOYS. Flewitt, P. E. J.; Palmer, D. E. B. (Central Electricity Generating Board, Barnet, Eng.). J. Less-Common Metals; 32: No. 1, 57-78(Jul 1973).

An investigation was conducted on the deformation characteristics of niobium–zirconium alloys in a composition range with optimum superconducting properties. The tensile properties of polycrystalline β-phase niobium containing 16 to 40% zirconium were established within the temperature range 4.2 to 800°K. The resolved shear stresses for yield (τ_y) and fracture (τ_f) decreased with increasing temperature up to approximately 0.2 T_M above which an athermal plateau forms. Within the athermal range, solid solution strengthening occurs, which up to ~25% zirconium, obeys a relationship based upon an atomic misfit parameter. Above ~25% zirconium, there is a decrease in strengthening. A model which describes the variation of τ_y within the thermally activated temperature range is the Peierls mechanism which involves thermal activation of kinked dislocation pairs. The deformation modes, both slip and twinning, together with the dislocation structures were analysed and correlated with changes in yield and fracture. At temperatures within the athermal temperature range, ductile fracture occurs, but at lower temperature brittle fracture is observed. Basically, additions of zirconium up to ~25% have a similar effect on deformation behavior as decreasing the temperature of deformation in pure niobium. (9 figures, 35 references) (auth)

11286 FERROMAGNETIC Gd_7Pd_3 AND OTHER RARE-EARTH-PALLADIUM COMPOUNDS WITH NON-CENTROSYMMETRIC Th_7Fe_3 STRUCTURE. Moreau, J. M.; Parthe, E. (Univ., Geneva). J. Less-Common Metals; 32: No. 1, 91-96(Jul 1973).

The earlier reported compound Gd_5Pd_2 has actually the composition Gd_7Pd_3 and crystallizes with the hexagonal Th_7Fe_3 structure type: space group $P6_3mc$, a = 9.980 Å and c = 6.276 Å. The compounds La_7Pd_3, Ce_7Pd_3, Pr_7Pd_3, Nd_7Pd_3, and Sm_7Pd_3 were found to be isotypic with Gd_7Pd_3. (auth)

11287 ELECTRONEGATIVITY PARAMETER FOR TRANSITION METALS: HEAT OF FORMATION AND CHARGE TRANSFER IN ALLOYS. Miedema, A. R. (Philips Research Labs., Eindhoven, NL). J. Less-Common Metals; 32: No. 1, 117-136(Jul 1973).

It is demonstrated that a cellular model gives an excellent account of the heat of formation of binary alloys of 27 transition metals. The energy effects are described by two terms, the first representing the difference in electronegativity between the two types of atoms in an alloy and the second term reflecting the discontinuity in the density of electrons at the boundary between dissimilar Wigner–Seitz atomic cells. The electronegativity is expressed in a scale which closely resembles that of the experimental work functions of pure metallic elements. The use of this scale also gives a clear insight into the heat effects which accompany the alloying of transition metals with nontransition metals. If the latter have p electrons, a negative term adds up to the heat of formation which apparently does not depend on the particular metals considered. As a result, simple rules for the alloying behavior of transition metals are formulated which have an accuracy between 96 and 100%; the electronegativity concept is shown to apply also for hydrogen in metals. The relation between the charge transferred per atom, ΔZ_a, and the difference in electronegativity, $\Delta\phi^*$, is discussed quantitatively. As an example, the result for solid solutions of two transition metals is $\Delta Z_a = 1.2\,(1-c_a)\Delta\phi^*$, where c_a is the concentration of metal A. The analysis supports the idea that the work function of a metal is, in principle, proportional to the chemical potential for electrons in Wigner–Seitz atomic cells; the proportionality factor is found to be about $1 \cdot 4$. (50 references) (auth)

11288 QUENCHING STUDIES OF HIGH-PURITY BETA AND GAMMA PLUTONIUM. Allen, R. P.; Nelson, R. D.; Arrowsmith, H. W. (Battelle Pacific Northwest Labs., Richland, WA). Journal of Nuclear Materials; 47: No 2, 168-172(Jun 1973).

A spray quenching system employing liquid nitrogen and high pressure helium was used to investigate the effect of cooling rate on the temperature of the $\beta_\gamma \rightarrow \alpha$ and $\gamma \rightarrow \alpha$ transformations in high-purity plutonium (β_γ, β_α is beta phase formed from γ or α phase respectively). Quenching rates up to 1500°C/sec were obtained at 100°C and below. The start temperature for the $\beta_\gamma \rightarrow \alpha$ transformation decreased rapidly with increasing cooling rate and β_γ was retained at rates greater than 600°C/sec. The $\beta_\gamma \rightarrow \alpha$ transformation temperatures were higher and β_γ could not be retained in lower-purity plutonium. The start temperature for the $\gamma \rightarrow \alpha$ transformation decreased slowly with increasing cooling rate, and γ could not be retained even at the maximum rate of 1500°C/sec. The subzero $\beta \rightarrow \alpha$ transformation temperatures for retained β_γ and β_α were determined for plutonium quenched to –196°C and then warmed to room temperature. The retained β_α transformed to α at higher temperatures than the retained β_γ, except immediately after a $\beta_\gamma \rightarrow \alpha$ transformation. Further, the subzero $\beta_\alpha \rightarrow \alpha$ transformation was progressively retarded by prior $\alpha \rightleftharpoons \beta$ transformation cycling. These subzero transformation temperature observations are consistent with the difference in $\beta_\gamma \rightarrow \alpha$ and $\beta_\alpha \rightarrow \alpha$ reaction behavior at high α-phase transformation temperatures. (auth)

11289 VARIATION OF THE RESISTIVITY OF COLD-WORKED NIOBIUM AND INFLUENCE OF THE PHENOMENA ON DIFFUSION OF INTERSTITIALS. Houssin, B. (Institut National des Sciences et Techniques Nucleaires, Saclay, France); Fries, J. F.; Cizeron, G.; Lacombe, P. J. Less-Common Metals; 32: No. 1, 137-153(Jul 1973). (In French).

An investigation of the variation of the electrical resistivity of niobium, measured at 77 to 293°K, was carried out on a sample previously 90% cold-worked at room temperature and annealed at

temperatures between 20 and 1000°C. These measurements may be depicted by two similar curves, which may be schematically divided into four stages in which different intervening diffusion-controlled processes occur. Diffusion of interstitial materials (O,C,N) is predominant in the first range of the annealing process (80 to 350°C); in fact, between 80 and 160°C, oxygen atoms migrate towards the dislocations, thereby forming Cottrell atmospheres, the activation energy of the process being 25,300 cal mole^{-1}. In the second annealing stage (350 to 550°C), an increase in the electrical resistivity is observed which may be due to re-entry of the interstitial atoms into the solid solution. The third annealing stage (550 to 700°C) is characterized by a decrease in the resistivity together with a sharp decline in the mechanical properties: these changes are connected with a recrystallization process. Finally, the rise in resistivity at higher annealing temperatures is probably due to superficial contamination of the specimens. (12 figures, 66 references) (auth)

11290 PRECISION LATTICE PARAMETER STUDIES OF ION-IMPLANTED SILICON. Pihl, C. F.; Bieber, R. L.; Schwuttke, G. H. (International Business Machines Corp., Hopewell Junction, NY). Phys. Status Solidi (a); 17: No. 1, 359-369(16 May 1973).

Precision lattice parameter measurements on silicon crystals after 1 MeV N^+ bombardment are reported. The measurements are based on Bond's method of using an automated Apex diffractometer. Up to one million digital count data are taken at each position in the reflection curve, collected on magnetic tape and computer analysed. Thus a precision of $1:10^6$ is obtained. Measurements are made at a number of positions across the wafer surface, so as to include reference regions not subjected to ion implantation. The results indicate an increase in lattice constant with ion dose. The lattice constant reaches a plateau value after an increase of $4:10^5$ relative to the unbombarded lattice. Results confirm the previously proposed model of radiation damage in silicon after high-ion-energy implantation. (auth)

11291 SPECTROSCOPIC PROPERTIES OF $La_2Be_2O_5:Nd^{3+}$ SINGLE CRYSTALS. Voronko, Yu. K.; Maksimova, G. V.; Osiko, V. V.; Sobol, A. A.; Starikov, B. P.; Timoshechkin, M. I. (Lebedev Inst. of Physics, Moscow). Phys. Status Solidi (a); 17: No. 1, K41-K43(16 May 1973).

The $La_2Be_2O_5$ and $La_2Be_2O_5:Nd^{3+}$ single crystals were grown from the melt by the Czochralski technique. Platinum and platinum–rhodium crucibles were suitable. Air, nitrogen, or vacuum (10^{-2} torr) were used as growing atmospheres. The absorption spectra of undoped crystals and both the absorption and luminescence spectra and the decay time of the $^4F_{\frac{3}{2}}$ level of Nd^{3+} in Nd-doped crystals were investigated. The spectral investigations were carried out by the technique described by Voronko, Kaminskii, and Osiko in 1965. (JCW)

11292 OBSHCHIE ZAKONOMERNOSTI V STROENII DIAGRAM SOSTOYANIYA METALLICHESKIKH SISTEM. (General Regularities in the Construction of Phase Diagrams of Metallic Systems). Ageev, N. V. (ed.). Moscow; Izdatel'stvo Nauka (1973). 200p.

The book is a collection of the 17 papers presented at the Fifth All-union Conference on the theme "General Regularities in the Construction of Phase Diagrams of Metallic Systems", held in June, 1971 at the Institute of Metallurgy, Moscow. The crystal chemistry of elements and its effects on phase diagrams, methods of predicting interaction of components, and novel experimental methods of constructing phase diagrams are examined. Papers were delivered on the following systems of particular interest: W–C–Me, where Me = Nb, Ta, and Re; Mg–Nd–Y–Zn; and Zr–Fe. Also included is a paper on the solubility of impurities in Be. (KSW)

11293 SPACE–ENERGY DISTRIBUTION OF REACTOR NEUTRONS IN METAL HYDRIDES. Vasil'ev, G. A.; Veselkin, A. P.; Egorov, Yu. A.; Orlo, Yu, V.; Pankrat'ev Yu. V.; Piskunov, V. I. Vop. Fiz. Zashch. Reaktorov; No. 5, 91-105(1972). (In Russian).

Current designs of the shielding of nuclear reactors include hydrogen-containing materials, the presence of which in the shield makes it possible to shorten the size of the shielding and reduce the contribution to the power of the dose from neutrons of intermediate energies. Various hydrogen-containing materials are used in the shield: water, polyethylene, paraffin, concretes with an increased concentration of hydrogen such as Serpentinite concrete, etc. Metal hydrides may also be included in such materials. Metal hydrides have a high nuclear density of hydrogen, in some cases exceeding the nuclear density of hydrogen water. From a study of the passage of neutrons through metal hydrides, the perturbing effect of the metal nuclei on the form of the attenuation function or the form of the energy distribution of neutrons and the role of the metal in the accumulation of moderating neutrons may be shown. The problem of the passage of neutrons through lithium, magnesium, titanium, and zirconium hydrides was investigated. The experiments were conducted on a water cooled-water moderated research reactor. (8 tables, 37 references) (JPRS)

11294 ATOMNYE STOLKNOVENIYA NA POVERKHNOSTI TVERDOGO TELA. (Atomic Collisions on the Surface of a Solid Body). Ayukhanov, A. Kh. (ed.). Tashkent; Izdatel'stvo FAN Uzbekskoi SSR (1972). 128p.

The interaction of corpuscular fluxes on the surfaces of solid bodies are examined. The phenomena of scattering, channelization, neutral ions, and ionic and electron emission are considered. Problems in connection with the effect of ion bombardment on the physicochemical properties of the surface are explored. The chief topics include the reflection of decelerated ions of alkali metals from the surface of a solid body, the scattering of alkali metal ions by the surface of metallic and semiconductor poly- and single crystals, and the energy distribution of ions thus scattered. Special consideration is given to scattering by Mo crystals and the energy spectra of electrons of kinetic emission at high energies of the bombarding ions. 307 references. (KSW)

11295 DISCUSSION OF THE "THE SURFACE SELF-DIFFUSION OF Mo, Cb(Nb), and Re". Clum, J. A. (Univ. of Wisconsin, Madison). Met. Trans.; 4: No. 7, 1763(Jul 1973).

B. C. Allen (Met. Trans., 3: 2544-7(1972)) determined that Nb surface self-diffusion followed the equation $D_s = 0.43 \exp[(-46{,}000 \pm 2600)/kT]$. Field-emission studies by the author resulted in an activation enthalpy of 48,100 cal/mol for 99.999% pure Nb. For less-pure Nb (99.7% pure), the activation enthalpy was 89,000 cal/mole, and the field-emission image was changed. Thus, a bulk impurity effect was observed. (DLC)

11296 PROPERTIES OF COATED REFRACTORY METALS. Gibeaut, W. A.; Bartlett, E. S. pp 113-206(Pt.2) of Coatings of High-Temperature Materials. Pts. 1, 2, and 3. Hausner, H. H. (ed.). New York; Plenum Publishing Corp. (1966).

Information generated since the middle of 1961 on the chemical, physical, and mechanical properties of refractory metals that are coated with oxidation-resistant coatings of advanced-experimental or commercial status is summarized. It is a supplement to DMIC Report 162, "Coatings for the Protection of Refractory Metals from Oxidation", dated November 24, 1961. Recent data on specific silicide- and aluminide-type coatings for Nb, Mo, Ta, and W and their alloys reflect general advances in coating quality and performance, understanding of the behavior of coated systems, and more complete realization of the problems associated with the use of coated hardware. Programs to provide comparative evaluations of coatings on Nb and Mo alloys have pointed up some of the relative merits and deficiencies of the various coatings. Properties that have been studied and evaluated in recent investigations include: oxidation lives at various temperatures and pressures; degradation in low-temperature ductility of substrates by coatings or coating processes; degradation of mechanical properties by oxidation exposure (thermal stability); effects of strain at low and high temperatures on protectiveness of coatings; stress-rupture and creep data of coated systems; fatigue properties of coated systems; and emittance of coatings. (49 references) (auth)

11297 ANISOTROPY OF ELASTIC ELECTRON SCATTERING IN ENERGY-LOSS EXPERIMENTS ON TELLURIUM. Bammes, P. (Univ., Munich). Phys. Status Solidi (b); 57: No. 1, K19-K20 (1 May 1973).

The energy-loss intensity can be obtained only as a convolution of the energy-loss function with the angle and energy distribution functions. Energy-loss measurements of fast electrons yield a loss intensity which is, in the case of very high energy and angle resolution, proportional to the energy-loss function. However this resolution cannot be achieved experimentally. An expression for the correction of the convolution with the angular distribution is given. A Möllenstedt-type analyzer was used in the experiments on tellurium films. An explanation was made of the discrepancy of loss functions obtained from optical and energy-loss experiments. (JCW)

11298 ELECTRONIC STRUCTURE AND SURFACE PROPERTIES OF TRANSITION METALS. Goryachev, Yu. M.; Poschernyaeva, L. A. (Inst. of Problems in Materials Science, Kiev). Phys. Status Solidi (b); 56: No. 2, 443-451(1 Apr 1973). (In German).

Using the GO LCAO treatment (tight-binding approximation) the energy spectrum of valence electrons for the (111) and (110) planes of Mo, W, and Re crystals (with hypothetic bcc structure) is calculated to analyze the correlation of the magnitudes and the electron populations of the s and d states of the surface atoms. It is shown that the anisotropy of the electron work function is related to the electron population of the surface atoms. (27 references) (auth)

11299 INVESTIGATION OF THE ELECTRONIC STRUCTURE OF MOLYBDENUM SINGLE CRYSTAL SURFACES BY MEANS OF

THE POSITRON-ANNIHILATION METHOD. Adonkin, V. T.; Dekhtyar, I. Ya.; Silantev, V. I. (Inst. of Metal Physics, Kiev). Phys. Status Solidi (b); 56: No. 2, 603-608(1 Apr 1973).

A model is proposed explaining the fine structure of angular distribution curves of annihilation photons (ACAP) obtained by the interaction of positrons with the electron density on the crystal surface. Data were presented that prove the influence of a deformation on the (110) plane of Mo and of weak magnetic fields (1.2 Oe) on the shape of ACAP curves obtained from the surface of this crystal face. The deformation effect is discussed in conjunction with the interaction between positrons and crystal structure defects on the crystal surface. The influence of a weak magnetic field is discussed with the excitement of the surface magnetic levels. (auth)

11300 SCATTERING MECHANISMS OF CONDUCTION ELECTRONS IN TRANSITION METALS AT LOW TEMPERATURES. Volkenshtein, N. V.; Dyakina, V. P.; Startsev, V. E. (Inst. of Metal Physics, Sverdlovsk, USSR). Phys. Status Solidi (b); 57: No. 1, 9-42(1 May 1973).

The available experimental data on the temperature dependence of the electrical resistance of transition metal allows for a conclusion that the temperature-dependent part of the resistance of nonferromagnetic metals at sufficiently low temperatures ($T \lesssim 10°K$) is mainly due to the scattering of conduction electrons by interelectronic collisions. The contribution of electron–photon scattering to the electrical resistance of transition metals at $T \lesssim 4.2°K$ is by one order smaller than ρ_{ee}. It is necessary to take into account the peculiarities of the electronic structure and the topology of the Fermi surface of the given metal as well as the possibility of electron–electron umklapp processes. In the electrical resistance of magnetically ordered transition metals at low temperatures an additional contribution is introduced by the scattering of conduction electrons by spin waves and is extraordinarily great in the case of magnetically ordered rare-earth metals, exceeding the value of the electron–electron resistance by several times and that of the electron–phonon resistance by more than one order. The character of the temperature dependence $\overline{\rho}_{em}$ (T) is determined by the peculiarities of the energy spectrum of spin waves. Therefore, experimental investigations of the temperature dependence of the contribution due to spin-wave scattering enables one to get information on the type of the spin-wave dispersion law, and to estimate the value of the energy gap. (96 references) (auth)

11301 ATOMISTIC EXPRESSION OF THERMAL EXPANSION OF METALLIC ELEMENTS. Plendl, J. N. (Air Force Cambridge Research Labs., Bedford, MA). Phys. Status Solidi (b); 57: No. 1, 187-191(1 May 1973).

It was shown recently that the coefficient of thermal expansion of metallic elements is proportional to the valency that is effective between any two next-neighbor atoms within the atomic coordination of crystalline structure, at ambient conditions of pressure and temperature. Presently, the Grueneisen parameter γ is shown to be a function of the atomic coordination number. Combining the two results leads to an expression for the thermal expansion based entirely on absolute constants and atomic parameters. Seventy percent of 48 elements, examined in this way, obey a single atomistic expression. The remaining thirty percent, belonging to group II, subgroup IVB, and to the lanthanides, have, in principle, the same expression, however, with different numerical factors, indicating a relative reduction of the thermal expansion, which increases in that order. (auth)

11302 PHASE DIAGRAM OF THE Pr_2O_3–SrO SYSTEM. Lopato, L. M.; Lugin, L. I.; Shevchenko, A. V. (Inst. of Problems in Materials Science, Kiev). Ukr. Khim. Zh.; 39: No. 2, 142-144(Feb 1973). (In Russian).

The phase diagram was constructed for the system Pr_2O_3–SrO over the interval 1300 to 2300°C using annealing and quenching techniques. New phases identified in this system include a β phase with a region of homogeneity near the composition 2 : 1, and the compounds 4 $Pr_2O_3 \cdot 5$ SrO and 2 $Pr_2O_3 \cdot 3$ SrO. The effect of SrO on the temperature changes of the polymorphic conversions of the H and X forms of Pr_2O_3 was studied. The previously constructed phase diagram for the system Nd_2O_3–SrO was made more precise with the aid of data from differential thermal analysis. (tr-auth)

11303 EFFECTS OF ARGON PRESSURE ON THE PROPERTIES OF SPUTTERED TANTALUM FILMS. Westwood, W. D.; Boynton, R. J.; Wilcox, P. S. (Bell-Northern Research and Development Labs., Ottawa). Thin Solid Films; 16: No. 1, 1-25 (Apr 1973).

The properties of tantalum films sputtered onto glass substrates over a wide range of sputtering conditions have been investigated. The films were sputtered at argon pressures between 9 and 80 mtorr and at voltages between 2.0 and 5.8 kV. The sputtering system was basically a dc diode system but an electron-emitting filament was also used to increase the range of sputtering conditions and to control the current independently of the pressure. At pressures below 15 mtorr, with voltages between 2.0 and 5.8 kV, the film resistivity was 210 $\mu\Omega$ cm, but it increased with increasing pressure and decreasing voltage; at 50 mtorr, the resistivities of films sputtered at 4.0 and 2.0 kV were 270 and 2100 $\mu\Omega$ cm respectively. Resistivities as high as 8000 $\mu\Omega$ cm were obtained at 2.0 kV and 80 mtorr. As the resistivity increases from 200 to 8000 $\mu\Omega$ cm, there is a decrease in the film density from 14.5 to 8.2 g cm^{-3}, the temperature derivative of resistivity becomes more negative and the β-Ta structure loses its strong (100) orientation. These effects are very similar to those reported for oxygen-doped tantalum films and the structure of the present films is probably similar. In this case, the oxygen is incorporated in the film both during and after sputtering. After deposition, measurements of the film resistance were made as a function of time. The resistivity increased when oxygen was supplied to the system and when the system was vented to atmosphere. The change in resistance increased with the final resistivity; increases between zero and 140% were recorded for films with final resistivities between 210 and 8000 $\mu\Omega$ cm respectively. The surfaces of the films, after reaching their final resistivities, were examined by electron microscopy. As the resistivity increased to 1100 $\mu\Omega$ cm, the film surface became increasingly rough due to the presence of large numbers of almost hemispherical hillocks with diameters of approximately 200 Å. With further increase in resistivity, the surface became smoother again. (28 references) (auth)

11304 ASTM STANDARDIZATION ACTIVITIES IN THE FRACTURE TESTING OF BERYLLIUM. Brown, W. F. Jr. (Lewis Research Center, Cleveland). J. Test. Eval.; 1: No. 2, 87(Mar 1973).

A Task Group on Fracture Toughness Testing of Beryllium was established in 1970. While the fatigue cracking problem appears to be solved, other problems and unusual behavior have been revealed. (DLC)

11305 FRACTURE TOUGHNESS OF BERYLLIUM. Conrad, H. (Univ. of Kentucky, Lexington); Hurd, J.; Woodard, D. J. Test. Eval.; 1: No. 2, 88-99(Mar 1973).

Data on the fracture toughness of beryllium obtained by the authors and that available in the literature are reviewed. The effects of test method, chemistry and microstructure, temperature and strain rate, and fracture modes are discussed. The available data suggest that the fracture toughness of both hot-pressed and sheet beryllium is proportional to the product of the true fracture stress and true fracture strain. A rationale for this correlation is developed on the basis of the Griffith–Orowan fracture equation. The effects of temperature and strain rate on the fracture toughness of beryllium sheet follow an Arrhenius-type relation which is in accord with that for prism slip. (4 tables, 16 figures, 23 references) (auth)

11306 CRACK-TOUGHNESS EVALUATION OF HOT-PRESSED AND FORGED BERYLLIUM. Jones, M. H. (Lewis Research Center, Cleveland); Bubsey, R. T.; Brown, W. F. Jr. J. Test. Eval.; 1: No. 2, 100-109(Mar 1973).

Fracture toughness tests at room temperature were made on three-point loaded beryllium bend specimens cut from hot pressed block and a forged disk. These specimens had plane proportions conforming to ASTM E 399 and covered a thickness range of from $\frac{1}{32}$ to $\frac{1}{2}$ in. Two sets of bend specimens were tested, one having fatigue cracks and the other 0.5 mil radius notches. During each test, records were made of the crack (or notch) mouth displacement and electric potential vs applied load. One objective of the investigation was the development of techniques to produce fatigue cracks in accordance with the procedures specified in ASTM E 399. This objective was achieved for the hot-pressed material. In-plane cracks were not consistently produced in the specimens cut from forged stock. Results of the fracture toughness tests showed that specimens with fatigue cracks had considerably lower values of K_{max} than those with sharp machined notches. Various anomalies were observed in the behavior of the beryllium specimens from hot pressed stock. Among these were nonlinearities in the load–displacement records in what was expected to be the elastic range, negative crack mouth displacements on unloading from this range, and a decrease in electrical potential with increasing load which was recoverable on unloading. While valid K_{Ic} values could not be established, the data indicate that for practical purposes a value of about 10 ksi-in.$^{\frac{1}{2}}$ would characterize both the hot-pressed and the forged stock. (auth)

11307 S-200 GRADE BERYLLIUM FRACTURE-TOUGHNESS PROPERTIES. Shabbits, W. O.; Logsdon, W. A. (Westinghouse Research Labs., Pittsburgh). J. Test. Eval.; 1: No. 2, 110-118 (Mar 1973).

S-200 grade vacuum hot-pressed beryllium fracture toughness

properties for both longitudinal and transverse orientations were generated in the temperature ranges between −320°F to 500°F and −320°F to 75°F, respectively. Limited data are presented for observations of fatigue behavior, fractography, dynamic and static tensile properties, and dynamic fracture toughness. Statistical bounds are given for fracture toughness data including a comparison of orientation effects. For longitudinally oriented specimens, fracture toughness increased linearly with temperature up to 300°F, and the 500°F results indicated a rapid increase above 300°F. Transverse fracture toughness was significantly higher and increased more rapidly with temperature than the longitudinal fracture toughness. Fatigue precracking experimentation revealed that beryllium does fatigue, but that current ASTM fatigue precracking procedures are impractical for general testing. In comparison to previously published notched specimen data, fatigue precracked specimens yielded significantly lower fracture toughness properties. (11 figures)

11308 HEAT TREATMENT EFFECTS ON THE MECHANICAL PROPERTIES IN Ti−6Al−6V−2Sn. Hickey, C. F.; Fopiano, P. J. (Army Materials and Mechanics Research Center, Watertown, CT). J. Test. Eval.; 1: No. 2, 166-169(Mar 1973).

The effect of heat treatment on the mechanical properties (including fracture toughness) of the titanium alloy Ti−6Al−6V−2Sn was investigated. Based upon a preliminary hardness survey of solution temperatures from 1300 to 1800°F, solution treatment temperatures of 1400, 1550, and 1700°F were selected for further aging heat treatments ranging from 700 to 1100°F for times up to 32 h. X-ray and electron microscopic observations and elastic modulus determinations were employed and correlated with the mechanical property data. A detailed discussion of the results and observations is given. (auth)

11309 STRESS RELAXATION IN ZIRCONIUM, TITANIUM, AND THEIR ALLOYS. Rodriguez, P.; Dasgupta, P.; Mannan, S. L.; Vagarali, S. S.; Samuel, K. G. (Bhabha Atomic Research Centre, Trombay, India). Scr. Met.; 7: No. 6, 671-679(Jun 1973).

Stress relaxation data on nuclear grade Zr, commercial-purity Ti, Zircaloy-2, and Zr−10 to 40 wt % Ti alloys were analyzed by the Li−Gupta method. This method is shown to break down for these metals and alloys. Plots of log stress rate vs stress and stress vs log time during relaxation are found to be linear at long times. The activation area may be independent of stress, and thus the Li−Gupta method fails since the velocity-stress exponent m* is a function of stress. Other possibilities are that the mobile dislocation density, the area swept after an activation event, or dislocation vibration frequency may vary with stress. (DLC)

11310 LOW-TEMPERATURE STRENGTH OF Fe−Mo SOLID SOLUTIONS. Meneses, P.; Champier, G. (Laboratoire de Physique du Solide, Nancy). Scr. Met.; 7: No. 6, 569-571(Jun 1973).

Evidence was obtained for the view that alloy softening may be due to the scavenging of interstitial impurities by Mo atoms. Two iron sources with differing interstitial impurity contents (I−impure; II−relatively pure) were used. 0.2% yield stress was measured at 77, 213, and 300°K for Fe−Mo solid solutions containing up to 6 at. % Mo; alloy softening was observed only at 77°K, and it had its maximum at 2% Mo. At this composition, and temperature, the alloy softening effect occurs for Fe(I) (48 kg/mm^2 for the alloy vs 63 kg/mm^2 for Fe(I) alone), but not for Fe(II) (38 and 40 kg/mm^2). (DLC)

11311 INFLUENCE OF OXYGEN CONTENT ON THE ATHERMAL $\beta-\omega$ TRANSFORMATION. Paton, N. E.; Williams, J. C. (Rockwell International, Thousand Oaks, CA). Scr. Met.; 7: No. 6, 647-649(Jun 1973).

In order to test the hypothesis that the scatter in ω retention might be caused by the variability of interstitial elements, Ti−V alloys containing 17, 18, 19, and 20 wt % V were prepared and charged with varying amounts of oxygen up to 1750 ppM. Electron diffraction patterns were taken during both heating and cooling of the samples, and the temperature for the ω formation (ω_s) was determined as the point at which ω reflections were first discerned above the streaking on cooling. Results show that oxygen lowers ω_s from 525°K (250 ppM) to 100°K (1750 ppM) in the 17% V alloy, and that the V composition required to stabilize the β phase varies inversely with oxygen content. The hysteresis in the $\beta-\omega$ transformation temperature increased with oxygen content, which is consistent with pinning of displacement defect by oxygen atoms. (DLC)

11312 DOMAIN STRUCTURE OF THE δ-PHASE ALLOY NiMo. Van Tendeloo, G.; Amelinckx, S. (Univ. of Antwerp). Mater. Res. Bull.; 8: No. 6, 721-731(Jun 1973).

Electron diffraction and electron microscopy were used to study the domain structure in the δ-phase NiMo. A remarkable microstructure due to the simultaneous presence of antiphase boundaries, inversion domains, and permutation twins was observed and could be analyzed by contrast experiments. (auth)

11313 NATURE AND BEHAVIOR OF GRAIN BOUNDARIES. Symposium Held at TMS-AIME Fall Meeting, Detroit, Michigan, October 18−19, 1971. Hu, H. (ed.). Metallurgical Society of AIME Proceedings. New York; Plenum Publishing Corporation (1972). 451p. (CONF 711071−). $25.00.

From symposium on the nature and behavior of grain boundaries; Detroit, Michigan, USA (18 Oct 1971).

The volume contains four unsolicited papers and thirteen invited papers presented at the TMS-AIME Fall Meeting in Detroit, Mich., Oct. 18-19, 1971. The presented papers are grouped into three sections under the headings: Structure of Grain Boundaries, Energetics of Grain Boundaries, and Grain Boundary Motion and Related Phenomena. An abstract was prepared for NSA for the paper entitled: Growth Selection in High-Purity Cadmium (JCW))

For an abstract of an individual paper see: 11314.

11314 GROWTH SELECTION IN HIGH-PURITY CADMIUM. Grey, E. A.; Higgins, G. T. (Illinois Inst. of Tech., Chicago). pp 371-388 of Nature and Behavior of Grain Boundaries. Hu, H. (ed.). New York; Plenum Publishing Corp. (1972).

From symposium on the nature and behavior of grain boundaries; Detroit, Michigan, USA (18 Oct 1971). See CONF-711071−.

Growth selection studies were performed with 99.9999% cadmium and a cadmium−5 atom ppM lead alloy. After severe local deformation, single crystals of a standardized orientation were annealed, resulting in the recrystallization of the heavily deformed region and the competitive growth of these recrystallized grains down the strain gradient into the single-crystal matrix. A three-dimensional orientation space was employed to describe the distribution of selected orientations, and six preferred orientations were identified. The relative preference for these preferred relationships is shown to be dependent on the single-crystal orientation, the solute concentration, and the annealing temperature. (auth)

Radiation Effects

Refer also to abstract 12073.

11315 (HEDL-TME-71-116) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, May−July 1971. Claudson, T. T. (ed.) (Hanford Engineering Development Lab., Richland, Wash.). Sep 1971. Contract AT(45-1)-2170. 417p. AT $23.00.

Results of research on radiation damage and other effects in reactor materials are summarized. Most of the effort during the period was devoted to steel and stainless steel. The research was conducted by Atomics International, Aerojet Nuclear Company, Argonne National Laboratory, Battelle Memorial Institute, General Electric Company, Hanford Engineering Development Laboratory, Naval Research Laboratory, Oak Ridge National Laboratory, Pacific Northwest Laboratory, and University of Cincinnati. (JRD)

11316 (HEDL-TME-72-64) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, February−April 1972. Claudson, T. T. (comp.) (Hanford Engineering Development Lab., Richland, Wash.). Jun 1972. Contract AT(45-1)-2170. 267p. Dep. NTIS.

See abstract for HEDL-TME-71-116. (JRD)

11317 (HEDL-TM-72-105) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, May, June, July, 1972. Claudson, T. T. (comp.) (Hanford Engineering Development Lab., Richland, Wash.). Aug 1972. Contract AT(45-1)-2170. 283p. Dep. NTIS.

See abstract for HEDL-TME-71-116. (JRD)

11318 (HEDL-TME-73-25) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, November 1972−January 1973. Claudson, T. T. (comp.) (Hanford Engineering Development Lab., Richland, Wash.). Mar 1973. Contract AT(45-1)-2170. 231p. AT $13.75.

See abstract for HEDL-TME-71-116. (JRD)

11319 (NAA-SR-9633) EFFECTS OF IRRADIATION ON HYDRIDED ZIRCONIUM−URANIUM ALLOY NAA-53 EXPERIMENTS. Miller, J. R.; Polak, D. A. (Atomics International, Canoga Park, Calif.). 30 Dec 1964. Contract AT(11-1)-GEN-8. 84p. Dep. NTIS $6.25.

Declassified 3 May 1973.

The effects of irradiation on the SNAP 8 uranium−zirconium hydride (N_H = 6.0) fuel element were evaluated in three capsules irradiated in the MTR. Six subscale prototype fuel elements were exposed to typical SNAP 8 temperatures at burnup levels from 1 to 3 times the expected SNAP 8 peak values. Post-irradiation examinations were made for fuel swelling, fission gas release,

microstructure, and hydrogen barrier coating effectiveness. These data are evaluated in terms of the SNAP 8 design, and are correlated with the capsule operating conditions. (auth)

11320 (NAA-SR-9648) EVALUATION OF FUEL ELEMENTS FROM SNAP 2 DEVELOPMENT REACTOR CORE. Olson, P. S. (Atomics International, Canoga Park, Calif.). 15 Jan 1965. Contract AT(11-1)-GEN-8. 36p. Dep. NTIS $4.00.

Declassified 17 April 1973.

The fuel elements used in the SNAP 2 Development Reactor contained a hydrided 90 Zr–10 U fuel/moderator rod and beryllium oxide reflectors, enclosed in ceramic-coated Hastelloy N cladding. The elements were in the core for 11,290 reactor operating hours, and produced a total energy release of 272,900 kWh. Peak fuel temperature at SNAP 2 conditions was 1279°F. Eight fuel elements were inspected at the hot cell after disassembly of the reactor. The cladding of two fuel elements which had been in contact with the beryllium internal reflectors had reacted with the beryllium, for a penetration of about 0.003 in. (about a $\frac{1}{8}$-in. diameter reaction zone). Apart from the small reaction zone on these two elements, all elements were in excellent condition. Measured burnup of the fuel/moderator material was 0.027 metal at.%. (auth)

11321 (NAA-SR-11304) POSTIRRADIATION EXAMINATION OF SNAP 8 CLADDING MATERIAL IRRADIATION EXPERIMENT NAA 77-4. Engberg, C. J.; Miller, K. J. (Atomics International, Canoga Park, Calif.). 15 Sep 1965. Contract AT(11-1)-GEN-8. 32p. Dep. NTIS $3.75.

Declassified 17 Apr 1973.

NAA 77-4 was the fourth capsule in an irradiation series designed to measure the radiation stability of SNAP 8 hydrogen barrier materials. The capsule contained a closed-end cladding tube, coated internally with the advanced SNAP 8 hydrogen barrier material, SCB-1. Irradiation of NAA 77-4 was begun in June of 1964, and the capsule failed when the temperature was increased to 1700°F. Postirradiation examination disclosed that a tensile force had been exerted on the capsule membrane during the rapid cooling of a reactor scram, resulting in a circumferential rupture. Metallographic examination showed the fracture to be intergranular, with many intergranular voids in the area near the fracture. The cladding material, Hastelloy N, exhibited low ductility in the area of failure, since none of the grains showed evidence of plastic deformation. (auth)

11322 (NAA-SR-11457) IRRADIATION STABILITY OF SCB-1 COATED HASTELLOY N. SNAP 8 FUEL CLADDING EXPERIMENT NAA 77-1. Engberg, C. J.; Miller, K. J.; Courtright, R. C. (Atomics International, Canoga Park, Calif.). 15 Oct 1965. Contract AT(11-1)-GEN-8. 50p. Dep. NTIS $4.50.

Declassified 24 May 1973.

NAA 77-1 was the first of a series of irradiation experiments designed to determine the radiation stability of SCB-1 hydrogen barrier material. The capsule contained a single SCB-1 coated cladding assembly, and was designed for use in determining the feasibility of performing an in-pile hydrogen permeation experiment and evaluating the neutron irradiation behavior of the hydrogen barrier material. NAA 77-1 was irradiated in an Engineering Test Reactor (ETR) facility (N-14 NW) from August 1963 to June 1964, during which time it received a fast neutron dosage of 1.54×10^{21} nvt ($E_n > 1$ MeV). The capsule operated for 4343 hr at a temperature between 1200 and 1500°F, and a hydrogen pressure of 3 atm abs. The hydrogen permeation rate at 1500°F averaged 0.37 cc/h at 3 atm hydrogen pressure, and 0.17 cc/h at 1 atm hydrogen pressure; these rates remained essentially constant throughout the test. These permeation rates were obtained by use of a mathematical partition function, to separate the hydrogen flow coming from a hot spot in the hydrogen supply line from the flow from the test membrane. The 3 atm pressure across the membrane resulted in a hoop stress of ~1200 psi. Measurements showed that the diameter of the Hastelloy N cladding tube had increased 0.5% during the irradiation. An additional 0.1% increase, making a total of 0.6% diameter increase, was measured at the locations of thermocouple strapping bands. The higher temperature under the thermocouple bands is believed to have caused this higher creep deformation, even though the temperature increase due to the bands was estimated at only 8°F. The average creep rate for NAA 77-1 was 10^{-6} in./in.-h, which is higher than predicted from extrapolated rates from higher stress short-time tests. Long-time low stress tests performed on nonirradiated samples also show a similar accelerated creep rate. Examination of the ceramic coating revealed good to excellent adherence to the Hastelloy N base material. The SCB coating was in excellent condition after irradiation, even though some unusual bubbles or blisters were observed. The Hastelloy N cladding material experienced a small grain growth during the irradiation, as did nonirradiated samples subjected to the same thermal treatment. Grains with diameters of 0.005 in. or greater covered a major fraction of the membrane cross-sectional area. The Hastelloy N grain boundaries became decorated with precipitated particles, in both irradiated and unirradiated samples, during long-time annealing. (auth)

11323 (NAA-SR-12033) ANNEALING STUDIES ON IRRADIATED SNAP FUEL. Schrag, F. C. (Atomics International, Canoga Park, Calif.). 26 Jun 1967. Contract AT(04-3)-701. 38p. Dep. NTIS $4.00.

Declassified 3 May 1973.

The SNAP annealing program was conducted to determine the dimensional stability of zirconium hydride fuel, 90% Zr and 10% U, by heating irradiated fuel of burnup as high as 0.6 metal at.%. Annealing temperatures of 1400 to 1700°F were selected to evaluate the temperature sensitivity of the fuel in the expected range of fuel centerline temperatures required for SNAP programs. The annealing program consisted of three major phases as follows: (1) Isothermal annealing at 1400 to 1700°F to determine temperature effects; (2) hydriding and dehydriding annealing to simulate various reactor conditions with changes of H_2 content in the fuel; and (3) thermal gradient annealing obtained by placing a 100°F/in. gradient on the fuel sample to simulate an axial thermal gradient in the reactor. It appeared that SNAP fuel irradiated to burnup as high as 0.6 metal at.% is dimensionally stable above the β phase; however, there was a relationship between fuel swelling and temperature for β-phase material. (JRD)

11324 (NAA-SR-12284) EMPIRICAL STUDY OF SNAP REACTOR FUEL IRRADIATION BEHAVIOR. Birney, K. R. (Atomics International, Canoga Park, Calif.). 10 Aug 1967. Contract AT(04-3)-701. 52p. Dep. NTIS $4.75.

Declassified 3 May 1973.

The growth of zirconium–uranium hydride fuel during irradiation at elevated temperature is reviewed historically. Correlations of the early experimental data with temperature and burnup are compared with the more recent data, including that obtained from the SNAP 8 Experimental Reactor (S8ER). A new empirical correlation of all the available zirconium–uranium hydride irradiation data is presented. Fuel growth is associated with the presence of zirconium–hydride phase phenomena superimposed on burnup effects, and the effects of the carbon additive, temperature, and other parameters are considered, but appear to be secondary in importance to hydrogen composition. A brief review of the zirconium–hydride phase diagram system is included. The results of the study are applied to the SNAP 8 Developmental Reactor (S8DR). Estimates of the fuel/clad contact probability based on the S8ER gap distribution and the proposed fuel correlation indicate that, for a minimum diametral gap of 6.4 mils, less than one element in the S8DR should be expected to have fuel/clad contact. Contact is defined as complete circumferential contact at any axial point. The estimate is based on 600 kWt/1300°F coolant outlet operation for 12,000 hr. (auth)

11325 (ORNL-TM-4055, pp 3.1-3.39) MECHANICAL PROPERTIES OF ALLOYS IN REACTOR ENVIRONMENTS AND DEVELOPMENT OF FAST REACTOR CLADDING AND STRUCTURAL ALLOYS. Jan 1973.

In fuels and materials development program quarterly progress report.

Activities in programs to determine the effects of neutron irradiation on reactor cladding and structural alloys are reported. Information and data are included on austenitic stainless steels, Ti-modified 316 stainless steel, transmission electron microscopic studies, mechanical properties of irradiated Al alloys, and effects of fast neutrons on W and W alloys. (JRD)

11326 EFFECT OF BOUNDARY SCATTERING ON THE HIGH-TEMPERATURE THERMAL CONDUCTIVITY OF SILICON. Savvides, N.; Goldsmid, H. J. (New South Wales Univ., Kensington). J. Phys., C (London); 6: No. 10, 1701-1708(24 May 1973).

The thermal conductivity of thin single crystals of silicon was measured at 293° and 197°K before and after neutron irradiation. It was observed that, after irradiation, there is an appreciable boundary scattering effect for crystals of thickness 20 to 100 μ. The effect is somewhat larger than predicted previously, but can be explained in terms of the phonon dispersion curves for silicon. (auth)

11327 TRAPPED HOLES AND TRAPPED-HOLE DIFFUSION IN DOPED CaF_2 CRYSTALS IRRADIATED BY CATHODE RAYS. Banerjee, H. D.; Ratnam, V. V. (Indian Inst. of Tech., Kharagpur). Physica; 65: No. 1, 97-108(1 Apr 1973).

The role of trapped holes in the luminescence of CaF_2 crystals doped with Mn alone and Ce and Mn together is investigated using low-energy cathode rays (10 kV, 40 μA) for irradiation. Like undoped samples, Mn-doped samples exhibit luminescence in the same spectral region which corresponds to the ($e + V_K$, V_H) re-

combination luminescence due to the formation of F_2^{-*} ions as transients during irradiation. The pronounced enhancement of this intrinsic luminescence of the parent lattice in Mn-doped samples is explained. The V_H band of this system is identified. With the incorporation of Ce also, the changes that occur in the cathodoluminescence spectra are explained. The conspicuous feature of the temperature dependence of luminescence, namely, the increase in emission intensities from room temperature (28°C) to 75°C, the rapid decrease at 100°C and the monotonic decrease thereafter up to 250°C is explained. These variations are shown to be due to the changes in the site symmetries of Ce^{3+} ions and the charge reduction of these ions, the two competing processes that are responsible for the observed behavior up to 100°C. (auth)

11328 MEASUREMENT OF SELF-DIFFUSION IN SOLIDS BY NEUTRON ACTIVATION OF MASKED SAMPLES. Varshneya, A. K.; Cooper, A. R.; Diegle, R. B.; Chin, S. A. (Case Western Reserve Univ., Cleveland). J. Amer. Ceram. Soc.; 56: No. 5, 245-247 (May 1973).

A nonuniform distribution of a radioactive tracer was produced within a glass specimen by partially masking it with Cd and irradiating it with thermal neutrons. The calculated distribution of the tracer in the given geometry agreed reasonably well with the measured distribution. The latter, in turn, served as the initial condition for a self-diffusion experiment that gave results consistent with previous studies. This technique avoids problems associated with interfaces in conventional diffusion couples. (auth)

11329 VOID FORMATION IN IRRADIATED AUSTENITIC STAINLESS STEELS. Bement, A. L. Jr. (Massachusetts Inst. of Tech., Cambridge). Advan. Nucl. Sci. Technol.; 7: 1-120 (1973).

Available literature on irradiation-induced void swelling in austenitic stainless steels is summarized. A comprehensive review of void formation in the various metals and alloys is not attempted in order to retain a central focus on materials of immediate interest to LMFBR application. However, nickel is included prominently in some sections, since it represents a high-purity homolog for austenite and since nickel-base alloys also have immediate and future application to LMFBR's. This article is divided into five major parts: I. Introduction and Background; II. Experimental Observations, which describes voids induced by neutron and charged-particle irradiation; III. Theory, which describes current theoretical descriptions of void nucleation and growth; IV. Practical Consequences of Void Swelling, which is devoted to mechanical behavior and design considerations; and V. Recapitulation, which summarizes some possible metallurgical corrective measures and identifies some problem areas requiring additional attention. (8 tables, 21 figures, 194 references) (LMT)

11330 OBSERVATION OF PARTIALLY ORDERED VOID LATTICE IN ALUMINUM IRRADIATED WITH 400-keV Al^+ IONS. Mazey, D. J.; Francis, S.; Hudson, J. A. (Atomic Energy Research Establishment, Harwell, Eng.). Journal of Nuclear Materials; 47: No. 2, 137-142(Jun 1973).

Transmission electron microscopy observations of voids formed in aluminum during irradiation at 50 and 75°C with 400-keV Al^+ ions, have shown that partially ordered void arrays are often present. These arrays occur in high-purity annealed aluminum, which was implanted with 10^{-4} atom/atom helium before ion irradiation. The void concentration is found to be $\sim 3 \times 10^{16}/cm^3$, and the void lattice parameter ~ 700 Å. The ratio of void lattice parameter to void radius is ~ 12. Ordered void lattices have been observed frequently in irradiated bcc metals but the only previous observation for a fcc metal was in nickel. Theoretical predictions of void lattices in metals are discussed and related to the observations reported. (auth)

11331 DAMAGE STRUCTURE FORMED IN MOLYBDENUM BY IRRADIATION IN A FAST REACTOR AT 650°C. Eyre, B. L.; Bartlett, A. F.; (Atomic Energy Research Establishment, Harwell, Eng.). Journal of Nuclear Materials; 47: No. 2, 143-154(Jun 1973).

Transmission electron microscopy was used to study the damage structure of commercially pure and zone-refined molybdenum irradiated in a fast reactor to a total dose of $\sim 3 \times 10^{22} n/cm^2$ at ~ 650°C. In all cases the structures consist of coarsely distributed dislocation segments and loops and a considerably finer distribution of small voids. The voids tend to be ordered on a bcc superlattice parallel to the underlying host lattice. Although the loops are predominantly interstitial in nature, a significant number of small vacancy loops are present in both the commercially pure and zone-refined materials. The formation of vacancy loops during irradiation can only be accounted for by in-site collapse of displacement spikes. The occurrence of such a process implies that the formation and growth of voids is dependent on emission of vacancies from the loops. An important practical consequence of having a high density of voids compared to other sinks for point defects is that the voids themselves act as dominant neutral sinks for vacancies and interstitials, leading to an early saturation in void growth. (22 references) (auth)

11332 NICKEL-ION BOMBARDMENT OF TYPE 304 STAINLESS STEEL: COMPARISON WITH FAST-REACTOR SWELLING DATA. Johnston, W. G. (General Electric Corp., Schenectady, NY); Rosolowski, J. H.; Turkalo, A. M.; Lauritzen, T. Journal of Nuclear Materials; 47: No. 2, 155-167(Jun 1973).

Annealed Type 304 stainless steel containing 15 atomic ppM of helium was bombarded with 5-MeV nickel ions at 525 to 700°C. A pronounced swelling peak occurs at 625°C, compared to a swelling peak temperature of about 475°C in reactor. TEM measurements of void swelling at 625°C as a function of ion dose show a swelling of almost 40% at 124 dpa without evidence of saturation. Measurements of gross swelling of the ion-bombarded material by a new step-height method provide information that is in good agreement with TEM data, and can be extended to larger swellings. The step-height results indicate a swelling of over 90% at 290 dpa at 625°C. The ion-produced swelling agrees well with in-reactor data when the two are compared at the respective peak swelling temperatures, and the void concentrations and average void diameters are comparable for the two cases. The high ion dose results are used to guide extrapolation of reactor data to higher fluences, leading to the following predictions for swellings at the peak swelling temperature in reactor: 18% swelling at 1×10^{23} n/cm² (fast), 50% at 2×10^{23}, and 80% at 3×10^{23}. (13 figures, 28 references) (auth)

11333 MAGNETIC RELAXATION IN NEUTRON-IRRADIATED IRON. Blythe, H. J. (Univ. of Sheffield, Eng.). Phys. Status Solidi (a); 17: No. 1, 293-304(16 May 1973).

Measurements of the magnetic aftereffect, observed as a time decrease of the initial susceptibility, were made on high-purity iron after irradiation with fast neutrons to a dose of 9.8×10^{18} n cm^{-2} at 45°C. Below 0°C strong relaxation peaks were observed at –68 and –13°C, in good agreement with earlier work, and attributed to the reorientation of impurity–interstitial clusters and to impurity interstitials. A strong relaxation was also observed in the region of –196°C and identified with the cold work peak of hydrogen in iron. Above 0°C a complex relaxation occurred which partially annealed out below 200°C. A Meechan–Brinkman annealing experiment gave an activation energy of (1.05 ± 0.03) eV; this was attributed to the migration of vacancy–impurity pairs. (auth)

11334 DIRECT OBSERVATION OF DEFECTS INDUCED BY IRRADIATION. Amelinckx, S. (SCK-CEN, Mol, Belgium). Rev. Roum. Phys.; 18: No. 1, 93-112(1973).

The electron microscope was used for direct observations of radioinduced defects such as dislocations, grain boundaries, twin boundaries, small precipitates, etc., in thin solid materials. The essential methods for the preparation of thin suitable specimens from 1000 to 2000-A thick include electropolishing, cleavage, crystal growth, chemical thinning, evaporated and sputtered films, beaten foils, chemical etching, ion thinning, and preparations from the melt. In order to introduce various defects in the materials, a large number of irradiation techniques are possible. (47 references) (JCW)

11335 HELIUM RE-EMISSION AND SURFACE DEFORMATION IN 316 STAINLESS STEEL DURING –170 to 700°C IMPLANTATIONS. Bauer, W. (Sandia Labs., Livermore, CA); Thomas, G. J. Journal of Nuclear Materials; 47: No. 2, 241-245(Jun 1973).

Reported are He re-emission measurements in Type 316 stainless steel during 300-keV implantation to 4×10^{18} He atoms/cm² at –170 to 700°C. Scanning electron microscopy was used to study the surface blisters that were formed. The He re-emission during implantation is found to be closely related to surface deformation; both re-emission and deformation are strongly dependent on implantation temperature. The characteristics of release and surface deformation in three main temperature regions are tabulated, with possible mechanisms. (DLC)

Other Materials

Refer also to abstracts 10955, 11151, 11160, 11165, 11167, 11198, 11199, 11260, 12018, 12056, and 12566.

11336 (AERE-R-7407) HETEROGENEOUS DECOMPOSITION OF ACETONE BY A 20% Cr–25% Ni–Nb STABILIZED AUSTENITIC STAINLESS STEEL AND OTHER MATERIALS. Part I. Kinetics and Deposit Characterization. Bennett, M. J.; Chaffey, G. H.; Langford, A. J.; Silvester, D. R. V. (Atomic Energy Research Establishment, Harwell (England)). Apr 1973. 85p. Dep. NTIS (U. S. Sales Only) $6.25. UK £1.50.

The kinetics of carbon deposition from acetone on a 20%Cr/25%Ni niobium-stabilized stainless steel and other materials were

studied at temperatures between 400 and 800°C. The other materials included yttrium-bearing 20/25/Nb and 15%Cr/4%Al ferritic stainless steels, Hastelloy X, nickel, silicon carbide, Fe_3O_4, α-Fe_2O_3, various Ni-, Fe-, Mn-, and Cr-based spinels, NiO, Mn_3O_4, Cr_2O_3, α-Fe_2O_3–Cr_2O_3, Al_2O_3, and the alumino-silicates Mobil Sorbead R and Triton. The individual reactions may be classified broadly into three groups. In the first (e.g., with Al_2O_3 and Cr_2O_3), where there had been least deposition, the substrate was unchanged and had directly catalyzed acetone decomposition. The solid products in the second group of reactions with more reactive materials (e.g., 20/25/Nb stainless steel and Fe_3O_4) were also primarily carbonaceous. However, in addition they contained inorganic constituents derived from the substrate, which participated in the mechanism by which carbon was formed. Prior to the onset of deposition, the chemical compositions of many of these materials were altered markedly by reaction with either acetone or its pyrolysis products. In the third group (e.g. with Mn_3O_4) the oxides were also reduced, but the subsequent extent of carbon formation was slight. Among these reactions the most active elements in promoting deposition were iron, particularly in some preparations of Fe_3O_4, and to a lesser extent, nickel. (auth)

11337 (AERE-R-7408) HETEROGENEOUS DECOMPOSITION OF ACETONE BY A 20% Cr–25% Ni–Nb STABILIZED AUSTENITIC STAINLESS STEEL AND OTHER MATERIALS. Part 2. Inhibition by Sulfur Poisoning. Bennett, M. J.; Chaffey, G. H.; Myatt, B. L.; Silvester, D. R. V. (Atomic Energy Research Establishment, Harwell (England)). Mar 1973. 18p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

Studies have been carried out on the inhibition of carbon deposition from acetone onto 20%Cr/25%Ni/Nb stainless steel, Fe_3O_4 and Cr_2O_3 by sulfiding and by the continuous addition of sulfur compounds to the gas phase. The gaseous poisons examined were thiophene, hydrogen sulfide, sulfur dioxide, and carbonyl sulfide and their relative effectiveness was established over a wide range of partial pressures (0.19 to 10^5 μatm). Sulfur poisoning reduced, and in some instances prevented, the deposition on Fe_3O_4. With sulfided material the inhibition could be attributed to a slow rate of formation of the catalytic intermediaries on $Fe_{1-x}S$ by comparison with Fe_3O_4. A similar mechanism applied under conditions of high partial pressures of hydrogen sulfide and of sulfur dioxide, which led to appreciable sulfiding. The gaseous poisons also inhibited deposition by their adsorption on catalytic sites in preference to acetone. Thiophene was particularly effective, as its larger molecular area could block several adjacent sites. Inhibition was obtained with the stainless steel, but was not as marked as for Fe_3O_4. Sulfiding reduced deposition for a limited period until new active sites were generated, while gaseous additives were only effective at high partial pressures. Sulfur poisoning did not affect deposition on Cr_2O_3, but this only partially explained its reduced efficiency for the steel by comparison with Fe_3O_4. (auth)

11338 (CONF-730601-) 11TH BIENNIAL CONFERENCE ON CARBON, GATLINBURG, TENNESSEE, JUNE 4–8, 1973. Extended Abstracts and Program. (Oak Ridge National Lab., Tenn.). 1973. 372p. Dep. NTIS $10.60.

Extended abstracts of papers submitted for presentation at the Eleventh Biennial Conference on Carbon are presented. The abstracts are grouped according to the session in which each corresponding full paper was presented. The sessions were on electronic properties, carbonization and graphitization, thermal properties, chemical reactivity, applications other than nuclear and aerospace, sorption, mechanical properties, intercalation compounds, nuclear fuels, nuclear graphite, and fibers and composites. (JRD)

11339 (COO-3574-95) STUDY OF IDEAL MAGNETIC CRYSTALS. Final Report, June 1, 1963–May 31, 1973. Wolf, W. P. (Yale Univ., New Haven, Conn.). 1973. Contract AT(11-1)-3574. 23p. Dep. NTIS $3.25.

A series of related experimental and theoretical research projects were designed to obtain detailed quantitative understanding of the thermal and magnetic properties of a number of relatively simple magnetic materials. These have included RCl_3 (with R = Ce, Gd, La: Gd and Eu: Gd), $CeBr_3$, $R(C_2H_5SO_4)_3 \cdot 9H_2O$ (with R = Ce and Dy), $R(OH)_3$ (with R = La, Nd, Eu, Gd, Tb, Dy, Ho, Er and Er: Tb), $Dy_3Al_5O_{12}$ (DAG), $Yb_3Ga_5O_{12}$ and $Na_3[Ce(C_7H_3NO_4)_3] \cdot 5H_2O$ (CDP). Little or no data are included here, but an extensive listing of work published during the contract is included. (95 references) (JCW)

11340 (SC-DC-721644) NONDESTRUCTIVE MEASUREMENT OF THE ELASTIC CONSTANTS OF UNIDIRECTIONAL BORSIC-FIBER-REINFORCED ALUMINUM COMPOSITES. Gieske, J. H.; Allred, R. E. (Sandia Labs., Albuquerque, N. Mex.). Mar 1973. 35p. (CONF-730511-2). Dep. NTIS $3.75.

From 3rd international congress on experimental mechanics conference; Los Angeles, California, USA (14 May 1973).

The complete orthotropic elastic stiffness matrix of unidirectional, Borsic filament-reinforced aluminum composites was experimentally evaluated for three different volume fractions by ultrasonic velocity measurements on thin plates. Longitudinal and shear velocity measurements were made in appropriate symmetry directions by direct contact or liquid immersion techniques. The elastic constants determined by this pulsed through-transmission method were in agreement with micromechanical theories based on the properties of the constituent materials. Agreement was also found between engineering constants determined by mechanical testing and those calculated from the ultrasonic data. Finally, measurement of the ultrasonic wave velocity has also been shown to be a rapid nondestructive test method for determining filament volume fraction in a fabricated part. (auth)

11341 (SGAE-2099) OPTICAL DETERMINATION OF THE ANISOTROPY OF PYROCARBON COATINGS. Koss, P.; Koizlik, K. (Oesterreichische Studiengesellschaft fuer Atomenergie G.M.B.H., Seibersdorf). Feb 1973. 22p. (CONF-720475-1). Dep. NTIS (U.S. Sales Only) $3.25.

From 4th meeting of the Dragon Project Quality Control Working Party; Grenoble, France (19 Apr 1972).

The irradiation behavior of pyrocarbon coated fuel particles is critically dependent on the anisotropy of the coating. A method for determining the anisotropy, based on the optical anisotropy of graphite single crystals, is described. The ratio of the reflectivities of a pyrocarbon section for polarized light with the E-vector parallel and perpendicular to the direction of preferred orientation is defined as optical anisotropy factor. Anisotropy profiles across the coating as well as irregularities can be determined by this technique. The theoretical and experimental basis and fully automatic measuring equipment are described together with the results obtained. (auth)

11342 (Y-1877) COMPUTER-SIMULATED X-RAY-DIFFRACTION DATA FOR DERIVATIVE STRUCTURES OF α-RHOMBOHEDRAL BORON. Holcombe, C. E. Jr.; Coffey, A. L. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). 31 May 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

Calculated x-ray-diffraction data were determined for α-rhombohedral boron derivative structures with oxygen, carbon, and phosphorus as the interstitial atoms. These data illustrate the types of formulas that can occur for such systems and show that these systems can be called ordered solid solutions. (auth)

11343 INTERACTION OF CARBON-GRAPHITE MATERIALS WITH GASES. Marmer, E. N.; Lyakhin, Yu. P. Porosh. Met., Akad. Nauk Ukr. SSR; No. 4, 75-86(Apr 1973). (In Russian).

Generalized results are given of research on the problems of gassing of carbon–graphite materials and their interaction with such gases as oxygen, nitrogen, water vapor, and carbon dioxide. Gassing of material is shown to be the less the higher is the degree of its graphitization, admixture purity, and compactness. However, a clear dependence is not always observed because of the effect of other factors. (auth)

11344 DATA GENERATION FOR ENGINEERING DESIGN WITH ADVANCED COMPOSITES. Hertz, J.; Forest, J. D. (General Dynamics Corp., San Diego, CA). pp 19-28 of Advanced Materials: Composites and Carbon. Buckley, J. D. (Comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466--.

The properties of graphite–epoxy composite materials for application in aircraft and missile structural components are evaluated. The mechanical tests results are given for high-strength graphite–epoxy systems. Anisotropy is indicated as a factor making the development of adequate elastic and strength properties in these materials more challenging than in isotropic materials. Their brittleness and the resulting high stress peaks at discontinuities are shown to complicate specimen designs. Also, their laminated structures are found to influence their consolidation characteristics and their mechanical and physical properties. As a consequence, they require substantially more design data and tests than more conventional materials. (IAA)

11345 HIGH STRENGTH–HIGH MODULUS BORON VAPOR DEPOSITED ON A CARBON MONOFILAMENT SUBSTRATE. Mehalso, R. M.; Diefendorf, R. J. (Rensselaer Polytechnic Inst., Troy, NY). pp 51-58 of Advanced Materials: Composites and Carbon. Buckley, J. D. (Comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466--.

A boron filament elongation measurement technique for boron deposition control during the fabrication of boron fiber by boron deposition from a boron trichloride–hydrogen mixture of a carbon monofilament substrate is described. The properties of carbon

substrates are shown to compare favorably with those of tungsten substrates. Diagrams are given to show the boron filament elongation vs. deposition time and vs. filament diameter at various flow rates. A tensile strength in excess of 500,000 psi was reached in boron fiber prepared by this technique. It is pointed out that high-strength, high modulus boron—and a lower-cost boron filament—can be obtained on carbon by this technique. (IAA)

11346 HIGH-PERFORMANCE GRAPHITE RIBBON: AN ADVANCED REINFORCEMENT MATERIAL. Froberg, R. W.; Conabee, E. E. (Pfizer Inc., Easton, PA). pp 69-75 of Advanced Materials: Composites and Carbon. Buckley, J. D. (Comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466--.

Tensile properties were tested in several hundred graphite ribbon specimens by a special technique minimizing parasitic stresses due to minor misalignments of the test samples. Measurements were also made to determine the crystalline structures, the delamination resistance, and the sink-float density of ribbon samples. Scanning electron microscopy was applied to investigate their surface. This ribbon is shown to have a potential as a high-strength and modulus reinforcement material. (IAA)

11347 FORMING AND PROCESSING ADVANCED COMPOSITES. Davis, L. W. (Harvey Aluminum Co., Torrance, CA). pp 117-132 of Advanced Materials: Composites and Carbon. Buckley, J. D. (Comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466--.

Discussions of boron–epoxy, graphite–epoxy, and boron–aluminum advanced composites as potential aircraft structural materials are presented. The tensile strength, elongation, modulus, and production cost of these materials are covered. Considerations are given as to how the cost of such materials could be reduced from the present $500 to $200 per pound. Metal matrix composite production forecasts are made running in excess of 3 million pounds in 1985. (IAA)

11348 ADVANCED FILAMENT-WOUND CARBON COMPOSITE. Guess, T. R.; Butler, B. L.; Theis, J. D. (Sandia Labs., Albuquerque, NM). pp 195-202 of Advanced Materials: Composites and Carbon. Buckley, J. D. (Comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466--.

The composite considered consists of carbon filaments and a chemical vapor deposited carbon as the matrix material. Materials properties data were obtained in tensile tests. The materials investigated included four different material configurations ranging from a single fiber to an angle-ply cylindrical specimen made from these fibers. It is found that the matrix axial strain to failure limits the composite performance because the high strength of the filaments is not fully utilized. The composite tensile modulus varies as a function of filament orientation. The variation agrees very well with predictions from two theoretical models. (IAA)

11349 DEVELOPMENT OF HIGH-STRENGTH THREE-DIMENSIONALLY REINFORCED GRAPHITE COMPOSITES. Taverna, A. R.; McAllister, L. E. (Avco Corp., Lowell, MA). pp 203-211 of Advanced Materials: Composites and Carbon. Buckley, J. D. (Comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466--.

The basic reinforcement concept involves the orientation of straight, noninterlaced yarns in three mutually perpendicular directions. Aspects of matrix processing are considered, giving attention to general processing procedures, matrix precursor studies, graphite fiber studies, and composite densifications. A composite materials evaluation is given, taking into account mechanical and thermal testing, ablative testing, and the microstructure of 3D graphite. Preliminary test results indicate that the material possesses excellent mechanical, thermal, and ablative properties. (IAA)

11350 GRAPHITE COMPOSITES FOR USE AS HOT-PRESSING DIES. Wise, D. C.; Trask, R. B. (Carborundum Co., Niagara Falls, NY). pp 223-227 of Advanced Materials: Composites and Carbon. Buckley, J. D. (Comp.). Columbus, OH; American Ceramic Society Inc. (1972).

From symposium on advanced materials: composites and carbon; Chicago, Illinois, USA (26 Apr 1971). See CONF-710466--.

Preparation and properties of carbon–graphite and carbon–carbon composites are described along with composite fabrication techniques used to produce materials tailor-made for the specific intended application. The two fabrication methods having the widest application are carbon filament wound carbon–carbon composites and flat lay-up carbon–carbon composites. Properties of these composites are presented tabularly and discussed. (JRD)

11351 ELECTRICAL AND THERMAL CONDUCTIVITY OF LOOSE AND FIBROUS GRAPHITIC CARBON MATERIALS AT HIGH TEMPERATURES. Etinger, I. A.; Mal'tseva, L. F.; Lyakhin, Yu. P.; Marmer, E. N. Heat Transfer–Sov. Res.; 5: No. 2, 7-10(1973).

The electric conductivity of particulate and fibrous carbon materials was measured and studied at 20 to 1700°C. It was found that the electric resistance of graphite grit decreased with increase in grit size. It was also found that in highly compacted graphite the electric resistance is the same in all directions. The thermal conductivity of graphite grit and felt was measured at 2000 to 2200°C. Results show that graphitic carbon felt has better thermal insulation properties than the graphite grit specimens. It was also found that the thermal conductivity of graphite felt with mats oriented crosswise to the direction of heat flux is less than that in mats oriented in the direction of heat flow. (JRD)

11352 PREFERENTIAL EJECTION PATTERN OF SPUTTERED KCl. Windawi, H. M.; Cooper, C. B. (Univ. of Delaware, Newark). Phys. Lett.; 43A: No. 6, 491-492(23 Apr 1973).

The sputtering of KCl crystals in an argon plasma has produced well-defined spot patterns when surface accumulation of potassium was minimal. [112] and [100] spots have resulted from the photon and low-energy ion irradiation of the (100) surface. (auth)

11353 SPATIAL DISTRIBUTION OF RADIATION DEFECTS IN SILICON IRRADIATED WITH BORON AND PHOSPHORUS IONS. Kumakhov, M. A.; Muralev, V. A. (Institute of Nuclear Physics, M. V. Lomonosov Moscow State University). Sov. Phys.–Semicond. 6: No. 8, 1350-1354 (Feb 1973).

The range of B, N, Al, P, As, and Ga ions and the straggling of B and P ions are calculated for silicon. Simple approximation equations are derived for the range of B and P. The range and straggling of B and P ions are used to calculate the distributions of radiation defects generated by B and P ions in silicon. This calculation is carried out for a wide range of ion energies. The case of irradiation of an oriented target, when the channeling effect is important, is also considered. (auth)

11354 IRRADIATION OF DIAMOND CRYSTALS WITH PROTONS. Gerasimenko, N. N.; Donina, V. I.; Lezheiko, L. V.; Sirochinskii, S. É.; Smirnov, L. S. (Institute of Semiconductor Physics, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys.–Semicond. 6: No. 8, 1292-1296 (Feb 1973).

A study was made of the influence of proton irradiation and subsequent annealing at 200–1000°C on the electrical properties and the cathodoluminescence spectra ($\lambda = 3500$–6000 Å) of diamond crystals. Such irradiation produced partly compensated semiconducting n–type layers in insulating crystals and it compensated semiconducting synthetic diamonds. Several vibronic series (N_3, N_4, etc.) appeared in the cathodoluminescence spectra at certain stages of annealing. The results obtained were explained on the assumption that radiation defects gave rise to compensation and formed disordered regions. (auth)

11355 INFLUENCE OF COPPER ON THE KINETICS OF ANNEALING OF RADIATION DEFECTS IN GERMANIUM. Gerasimov, A. B.; Dolidze, N. D.; Kasparyan, K. I.; Kakhidze, N. G.; Konovalenko, B. M.; (and others) (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Semicond. 6: No. 8, 1368-1371 (Feb 1973).

An investigation was made of the annealing of radiation defects in n– and p–type germanium doped with antimony, gallium, and copper. The impurity concentrations in n–type samples were $N_{Sb} = 3.8 \cdot 10^{14}$ cm^{-3} and $N_{Cu} = (4.7$–$8.6) \cdot 10^{13}$ cm^{-3} whereas the corresponding concentrations in p–type samples where $N_{Ga} = 1.10^{15}$ cm^{-3} and $N_{Cu} = 5.10^{15}$ cm^{-3}. These samples were irradiated at T = 77°K with 4.5 MeV electrons. The presence of copper in n–type samples resulted in a shift (toward lower temperatures) of the "reverse–annealing" and the electron–density–recovery stages. A similar shift of the hole–density–recovery stage and the absence of this stage at high temperatures were observed for p–type samples. These effects were attributed to an additional annihilation of vacancies resulting from their interaction with copper atoms displaced to interstitial positions by the irradiation–generated interstitial germanium atoms. (auth)

11356 FORMATION OF DISORDERED LAYERS IN ION BOMBARDMENT OF CRYSTALS. Romanov, S. I.; Smirnov, L. S. (Institute of Semiconductor Physics, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys.–Semicond. 6: No. 8, 1410-1411 (Feb 1973).

An attempt was made to study the formation of disordered layers, using electron diffraction, during the bombardment of silicon with positive ions of greatly differing masses ($^{40}Ar^+$, $^{20}Ne^+$, $^{11}B^+$). (CES)

11357 VIBRATIONAL SPECTRA OF YTTRIUM NIOBATE AND TANTALATE. Blasse, G. (State Univ., Utrecht). J. Solid State Chem.; 7: No. 2, 169-171(Jun 1973).

Infrared and Raman spectra of $YNbO_4$ and $YTaO_4$ are reported. These spectra show the internal vibrational modes of the NbO_4^{3-} and TaO_4^{3-} tetrahedra which occur seldom in solids. The ν_3 mode is situated at low wavenumbers relative to ν_1. This corresponds to low values of the force constants in the OVFF model. (auth)

11358 LOW-TEMPERATURE X-RAY AND PHOTOLUMINESCENCE OF LEAD HALIDE CRYSTALS. Liidja, G.; Plekhanov, V. (Inst. of Physics and Astronomy, Tartu, USSR). J. Lumin.; 6: No. 2, 71-76(Mar 1973).

The emission spectra of PbF_2, $PbCl_2$, and $PbBr_2$ monocrystals are measured under optical and x-ray excitation at liquid helium temperature. Certain emission bands are attributed to the radiative transitions in the self-trapped cation exciton (excited Pb^{2+} ion). The increase of trapped exciton via electron-hole recombination is discussed. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

11359 (BNL-17908) APPLICATION OF THE CONCEPTUAL DESIGN FACILITY REQUIREMENTS FOR SAFEGUARDS TO FIVE AEC LICENSE EXEMPT CONTRACTORS. Marcuse, W.; Sherr, T. S.; Ovuka, N. (Brookhaven National Lab., Upton, N. Y.). 1 Jun 1973. 11p. (CONF-730630-2). Dep. NTIS $3.00.

From 14th annual institute of nuclear materials management conference; San Diego, California, USA (20 Jun 1973).

The BNL Technical Support Organization (TSO) is developing a conceptual design for nuclear safeguards. The results of TSO's assignment to apply the conceptual design to a set of Commission facilities and to determine the actions needed and the costs of these actions if conceptual design performance at these facilities were to be obtained, are presented. (TFD)

Disposal and Storage

Refer also to abstracts 10754–10756, 10759, 10871, 10872, 11027, and 11242.

11360 (JPRS–58764, pp 47-61) SCIENTIFIC PREREQUISITES FOR BURYING HIGHLY ACTIVE LIQUID WASTES IN DEEP GEOLOGICAL FORMATIONS. Spitsyn, V. I.; Balukova, V. D.; Yudin, F. P.; Pimenov, M. K. 1972. Translation of SM–163/40.

Some conclusions of a study on burying highly radioactive liquid wastes in deep geological formations are: (1.) In the dumping of highly active liquid wastes into underground storage strata, it is necessary to provide conditions of stability and compatibility of the material of the stratum. (2.) Feasible methods for observation of stability of wastes and regulation of the accumulation of radioactive isotopes in the rocks consists of: reducing the acidity of the wastes, introducing complexing of the hydrolyzing of the components, modification of the surfaces of the rock by surfactants. (3.) A limiting magnitude of the activity of the wastes exists for underground burial, depending upon the absorption capacity of the rocks, determined by the permissible heating temperature of the stratum. (4.) One of the conditions determining the permissible heating temperature of the stratum obviously may be considered to be the vapor formation temperature of the liquid in conditions of stratum pressure. (5.) During the first period of the dumping of wastes into the stratum (1 to 2 years) the temperature is determined by the heat liberation of the short-lived isotopes, the temperature maximum, and the time that it sets in being determined by the heat liberation of the long-lived isotopes. (auth)

11361 (LFEN-RI-6) MANAGEMENT OF THE LIQUID RADIOACTIVE WASTE OF LFEN. Sequeira, F. P. C. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1972. 25p. (In Portuguese). Dep. NTIS (U.S. Sales Only) $3.25.

The criteria for the management of liquid wastes are defined. The permanent control of some radioactive and non-radioactive parameters is considered. The existing equipment for the processing of the liquid waste is examined to determine its adequacy and efficiency. (J.S.R.)

11362 DISCHARGE OF RADIOACTIVE LIQUID EFFLUENTS IN WATER AND THEIR CONTROL. Schwibach, J. (Bundesgesundheitsamt, Neuherberg, Ger.). Bundesgesundheitsblatt; 15: No. 18, 260-263(1972). (In German).

A survey is given on the actual and permitted discharge of radioactive liquid effluents from nuclear power plants in the FRG. The considerations on which the present licenses in the FRG are based, new problems arising from the use of cooling towers, the type of construction of nuclear power plants with zero discharge, and control methods are also reported. (GE)

11363 PRESENT STATUS AND TRENDS IN RESEARCH AND MANAGEMENT OF RADIOACTIVE WASTES. Czosnowska, W.; Minczewski, J. (Instytut Badan Jadrowych, Warsaw). Nukleonika; 18: No. 3, 143-157(1973). (In Polish).

The problems related to radioactive wastes are reviewed and discussed. The characteristics and management of radioactive wastes from research laboratories, industry, uranium mining industry, nuclear power plants and fuel reprocessing plants are discussed. The treatment of radioactive wastes in the Institute of Nuclear Research in Poland is presented. Trends in research activity on the management of radioactive wastes are indicated. (auth)

Handling Equipment and Procedures

11364 (HEDL-TME-73-36) CRITERIA FOR CRITICALITY SAFETY LIMITS AND CONTROLS AT HANFORD ENGINEERING DEVELOPMENT LABORATORY. Paglieri, J. N.; Rogers, C. A. (Hanford Engineering Development Lab., Richland, Wash.). Apr 1973. Contract AT(45-1)-2170. 19p. Dep. NTIS $4.00.

Criteria are presented which are used to establish criticality safety limits and controls for operations involving ^{235}U, ^{233}U, ^{239}Pu, and other fissionable materials outside of nuclear reactors and critical facilities. A discussion of administrative controls, design of processes or equipment, and criteria for transporting fissionable material can be found in the Criticality Safety Procedures Manual (WHAN-M-6) or in the literature and are not presented here. Although these criteria are intended to be complete, it is recognized that unforeseen circumstances may arise requiring special controls. (auth)

11365 (LA-5281-MS) TRANSURANIC WASTE RESEARCH AND DEVELOPMENT PROGRAM. Fowler, E. B.; Warren, J. L.; Pashman, K. A.; Healy, J. W. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 26p. Dep. NTIS $3.00.

The progress of the Transuranic Waste Research and Development Program at the Los Alamos Scientific Laboratory for the period Nov. 1, 1972 to March 1, 1973 is reviewed. The results of a survey of transuranic waste streams and waste management practices at six major AEC installations indicated the wide variety of wastes and waste handling practices in existence and the need for some uniformity in record keeping. Preliminary results of experimental studies of corrosion sources and mechanisms using 17C 55-gal drums suggest that unrelieved stress may be a major contributor to the corrosion of the drum. Combustion studies of typical waste types demonstrated the production of large quantities of smoke and gases but failed to produce a flame at temperatures up to 450°C. Leaching studies showed that plutonium is removed from the wastes by water at a rate that decreases after the first few hours of contact. Progress on the development of an assay system to detect radioactive contaminants in very low concentrations in waste is reported. (auth)

11366 (ORO-711) NUCLEAR FUEL CYCLE. Transportation Requirements Within the Southern Interstate Nuclear Board Region Through 1980. SINB/AEC Work Conference on Transportation of Radioactive Materials, Oak Ridge, Tennessee, May 16-17, 1973. (Oak Ridge Operations (AEC), Tenn. (USA). Research and Technical Support Div.). 1973. 24p. Dep. NTIS $3.25.

Uranium passes through six major steps in the process of being used as a fuel in a nuclear power reactor. These steps are milling, conversion, enriching, fabrication, reactor utilization, and reprocessing. Each step is an entity in itself and requires the movement of large quantities of materials between steps. Estimates of the quantities of materials that are expected to flow annually between these steps for the years 1974 through 1980 are given. Only those materials passing into, out of, or through the SINB region are considered. However, since a significant part of the nuclear fuel cycle facilities are located in the region, this movement of materials includes those required for the support of a majority of reactors in the United States as well as for a large number of foreign reactors. A separate estimate is given for the reactors located in the SINB region. The methods of transportation for each step to step movement vary. A brief description of the packaging and mode of transportation, with an accompanying illustration of a typical container, is shown for each step. To provide insight into the effect of the fuel cycle of one reactor on both the amount of materials moved and the monetary value of the steps, the fuel requirements and estimated costs for a model 1000 MW(e) reactor plant are presented. (TFD)

11367 (RFP-131) LARGE-SCALE REDUCTION OF HIGHLY ENRICHED URANIUM. Craig, R. P.; Peluso, R. F.; Troeltzsch, R. E. (Dow Chemical Co., Denver, Colo. Rocky Flats Plant). 26 Jan 1959. Contract AT(29-1)-1106. 19p. Dep. NTIS $3.00. Declassified Oct 1972.

Highly enriched uranium metal (greater than 90% ^{235}U) was produced from the tetrafluoride in approximately 15-kilogram batch size. (auth)

Transportation

11368 (ORNL-TM-4242) DESIGN AND ANALYSIS OF THE NEW BRUNSWICK LABORATORY HIGH-LEVEL WASTE CASK.

Evans, J. H. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 123p. Dep. NTIS $8.25.

The New Brunswick Laboratory High-Level Waste Cask was designed at Oak Ridge National Laboratory for use in transporting the high-level radioactive waste associated with chemical analysis of fuel element dissolver solution samples. The cask design was evaluated analytically to determine its compliance with the applicable regulations governing containers in which radioactive materials are transported. Computational procedures were used to determine the structural integrity and thermal behavior of the cask relative to the general standards for normal conditions of transport and the standards for the hypothetical accident conditions. The results of the evaluation demonstrate that the cask design is in compliance with the applicable regulations. (auth)

11369 INFLUENCE OF MATERIALS USED IN NUCLEAR TRANSPORT ON REACTIVITY OF SINGLE AND COUPLED MTR CORES. Blechschmidt, W.; Heintz, W.; Roethemeyer, H.; Schweer, H. H. (Physikalisch-Technische Bundesanstalt, Brunswick). Atomkernenergie; 21: No. 1, 1-4(1973).

To assess the safety of nuclear transport, the influence of reflector and coupling regions of different materials (lead, cadmium, steel, concrete, wood, plexiglass, paraffin, voids) on the reactivity of nuclear units was measured. For the experimental reactivity determination, the pulsed source method was employed. The measurements confirm the results of Klotzkin et al. that the presence of lead in the reflector region of the MTR core has a positive reactivity effect as compared to a pure water reflector. The same effect, but less significant, was observed with steel and plexiglass. Coupling regions of 14 cm of the above mentioned materials with the exception of paraffin and cadmium (0.1 cm) increase the overall reactivity of the coupled two-core system in comparison to a water-coupling region. Two-dimensional diffusion theory calculations with two energy groups underestimate the observed effects. (GE)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 11634, 11806, and 11813.

11370 (AD-751593) DEVELOPMENT OF AN ADVANCED PULSED ELECTRON BEAM ACCELERATOR. Final Report, January–August 1971. Champney, P.; Hatch, G. L.; Nielsen, K.; Shope, S.; Smith, I. (Physics International Co., San Leandro, Calif.). Oct 1972. Contract DASA01-70-C-0063. 105p. (PIFR-226; DNA-2864-F). NTIS.

The development of a 50-kJ generator capable of producing currents in excess of one megampere at voltages approaching one megavolt with a pulse width about 55 nsec is described. The concept is to feed an electron accelerating tube from two modules, each containing multiple Mylar striplines arranged in a series-parallel configuration. Each module contains 8 Blumleins with a total output of 0.5 MA to 1 MV. The modular concept permits the individual Mylar lines to be assembled in air and vacuum-impregnated with copper sulphate solution. The module and its striplines are easily attached to the accelerating tube. Additional modules can be added to the present design to increase the machine power output. (auth) (NTIS)

11371 (RL-73-2) NIMROD OPERATION AND DEVELOPMENT QUARTERLY REPORT, JANUARY 1–MARCH 31, 1973. Gray, D. E. (ed.) (Rutherford High Energy Lab., Chilton (England)). Apr 1973. 17p. Dep. NTIS (U.S. Sales Only) $3.00.

The Nimrod beam was on for High Energy Physics Research for 91.8% of HEP scheduled operating time. Four experiments continued through and an extension to a proposal was completed. Some details of the new 70 MeV linear accelerator injector for Nimrod are given. (auth)

11372 (SLA-73-5471) GENERATION, TRANSPORT, AND COMPRESSION OF AN ANNULAR INTENSE RELATIVISTIC ELECTRON BEAM WITH RETURN CURRENT FEEDBACK THROUGH THE CATHODE. Kelly, J. G. (Sandia Labs., Albuquerque, N. Mex.). 1972. 14p. (CONF-730529-2). Dep. NTIS $3.00.

From 12th symposium on electron, ion, and laser beam technology; Cambridge, Massachusetts, USA (21 May 1973).

The properties of an intense annular relativistic electron beam generated by a ring cathode and conical anode have been studied in detail. The beam is injected into a channel between concentric cones (containing a neutral gas for space charge and current neutralization) where it is transported and focused. Half of the return current is then fed back through the cathode to prevent radial pinching of the primary current sheet. On the Sandia Reba accelerator which generated a beam of about 120 kA at 1 MeV an area compression of 10 was achieved with 50 percent efficiency. The compressibility of the beam was found to depend primarily on the azimuthal temperature of the beam as it emerged from the diode and on the diode plasma closure rate. (auth)

Auxiliaries and Components

11373 (CERN-73-6) TWO DEVICES FOR OPERATOR INTERACTION IN THE CENTRAL CONTROL OF THE NEW CERN ACCELERATOR. Beck, F.; Stumpe, B. (European Organization for Nuclear Research, Geneva (Switzerland)). 24 May 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

The proton synchrotron currently being built by CERN (the SPS) will be controlled centrally from three control desks, each with its own mini-computer. Only a few knobs and switches are used to control all of the many thousands of digital and analog parameters of the accelerator, and an operator will watch the machine on at most a half-dozen displays. This might be considered as the multiplexing of the operator and his interface over all the subsystems of the accelerator, and carries with it all the disadvantages and advantages of multiplex systems in general. The disadvantage is that the method is certainly clumsy when compared with control rooms in which all variables are constantly accessible for control and observation. The operator will often experience a time-lag before the limited facilities available to him can be used to control or monitor some subsystem. An advantage of the new form of control, however, is that since there are so few controls and displays, they may be made more elaborate and powerful. Two devices are described and it is hoped that they will play an important part in control from the desks. The first of these devices is the touch screen. This is effectively a panel having a number of buttons with legends on them. The buttons are input devices to the computer, and the legends can be written by computer. This makes it possible for the operator to do a look-up in a very large table with only a few buttons, by presenting him successively with choices which depend on his previous decisions. The second device is a knob with feedback from the computer. This makes it practicable to use one knob, at will, as an incremental encoder, a multiposition switch, or as a velocity control with spring-return to zero. Both devices have been interfaced to the CAMAC system which is being used throughout the SPS control project. They are easily accessed by users of the interpretive control language, and can therefore be used to construct quite sophisticated interactive systems with little effort. (auth)

11374 (INS-J-141) STABILITY OF THE BEAM LEVEL IN THE INS ELECTRON SYNCHROTRON MEASURED BY A POLARIZATION EXPERIMENT. Kobayashi, M.; Nishikawa, T. (Tokyo Univ. (Japan). Inst. for Nuclear Study). 4 May 1973. 21p. Dep. NTIS (U.S. Sales Only) $3.25.

The horizontal beam position of bremsstrahlung from the INS electron synchrotron was measured during a few months and the results are discussed in relation to the stability of equilibrium orbit in the accelerator. The beam level was obtained from the center of the vertical distribution of the converted electron pair, which was momentum analyzed by a vertical magnetic field and detected by wire chambers. (auth)

11375 (LA-UR-73-604) REFLECTIONS UPON DESIGN CRITERIA FOR A GOOD ACCELERATING TUBE. McKibben, J. L. (Los Alamos Scientific Lab., N. Mex.). [nd]. 13p. (CONF-730530-1). Dep. NTIS $3.00.

A list of 15 criteria which must be satisfied for development of an accelerating tube with a gradient of 3 or 4 MV/m is given. The criteria are based upon interpretation of the discharge and sparking process operating in a tube. A proposed high-gradient tube is illustrated. (WHK)

11376 (LA-UR-73-855) USE OF MINICOMPUTERS IN PARTICLE ACCELERATORS. Gore, R. A.; Machen, D. R. (Los Alamos Scientific Lab., N. Mex.). 1973. 37p. (CONF-730508-4). Dep. NTIS $4.00.

From 6th conference on minicomputers and their applications; Honolulu, Hawaii, USA (2 May 1973).

The historical development of the use of minicomputers for accelerator control and data handling is reviewed; and the application of minicomputers to the accelerator beam diagnostics, experimental interface development, accelerator structure tuning, magnet field mapping, ion source operation, nuclear instrumentation, and data handling as practiced at LAMPF, and other accelerator laboratories throughout the world is discussed. (WHK)

11377 (LBL-1389) DESIGN FUNDAMENTALS OF CURRENT TRANSDUCERS FOR LARGE DC CURRENTS. Jackson, L. T. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 5p. (CONF-730310-59). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The design and operation of dc transductors are discussed. Topics include the single core transductor, core characteristics, multi-core transductors, and the feedback transductor. (WHK)

11378 NUCLEAR ELECTRONICS AND MEASURING TECHNIQUES. III. Radiation Protection at High-Energy Accelerators. Freytag, E. Karlsruhe, Ger.; Braun (1972). 120p. (In German).

This book attempts a survey for physicians, engineers and technicians of the state of their respective fields. This review occasionally goes over what is already known about radiation protection in reactors. The emphasis is on the important particulars of high-energy accelerators. In the first chapters the elementary interactions of particles with material reaching high energies and the hadron and the photon electron cascades are described. The following chapters deal with energy and equivalent dose, measuring equipment, shielding and radiation damage in materials particularly from the aspect of high-energy particle radiation. (GE)

Ion Sources and Injection and Extraction Systems

11379 (LA-UR-73-605) LAMB-SHIFT POLARIZED SOURCES AT LOS ALAMOS SCIENTIFIC LABORATORY. McKibben, J. L. (Los Alamos Scientific Lab., N. Mex.). [nd]. 15p. (CONF-730530-2). Dep. NTIS $3.00.

The design and operation of the LASL source of polarized H^- and D^- ions are described. Formation of the metastable atom beam, polarization of the metastable beam, selective conversion to negative ions, focusing and acceleration, modification of the argon cell for rapid reversal of polarization, and the polarized T^- source are discussed. (WHK)

11380 ACCELERATION OF NEGATIVE DEUTERON IONS AND BEAM EXTRACTION IN A CLASSICAL CYCLOTRON. Paic, G.; Lechpammer, T.; Babarovic, B. (Inst. Ruder Boskovic, Zagreb). Fizika (Zagreb); 5: No. 1, 57-60(Mar 1973).

The acceleration of negative ions provides a convenient method of beam extraction. Several modifications to the 16-MeV cyclotron at the Ruder Boskovic Institute to extract deuteron beams by this method are described. (TFD)

Ion Optics and Field Calculations

11381 (JINR-P9-7065) STABILITY OF COHERENT OSCILLATIONS OF AN ELECTRON RING IN A RESONATOR. Part I. Azimuthal Oscillations. Aleksakhin, Yu. I.; Korenev, I. L.; Yudin, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 19p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The stability of the electron ring oscillations in a cylindrical resonator is considered. The beam impedance is calculated taking into account the finite conductivity of the chamber walls. The beam stability with the energy spread both in resonances and out of them is analyzed. (auth)

11382 USKORYAYUSHCHIE VOLNOVODY. (Accelerating Wave-Guides). Val'dner, O. A.; Shal'nov, A. V.; Didenko, A. N. Uskoryayushchie Volnovody. Moscow; Atomizdat (1973). 216p.

The calculation and design of accelerating waveguides for use in linear and cyclic accelerators are treated. Special aspects of the subject are discussed: Errors in fabrication, instability of power supplies, and the motion of particles in synchrotrons with accelerating waveguides. 15 references. (KSW)

Experimental Facilities

Refer also to abstracts 10806, 10807, 10925, and 10927.

11383 (AAEC/E-249) COMPUTER-TO-COMPUTER DATA LINK FOR A PDP7 AND PDP15. Tighe, L. E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec 1972. 25p. Dep. NTIS (U. S. Sales Only) $3.25.

A data link for the PDP7 and the PDP15 computers for data collection and experimental control at the Australian Atomic Energy Commission 3-MeV accelerator facility is described. The PDP7 is master and the PDP15 is slave. (WHK)

11384 (LA-UR-73-413) PROTOTYPE TESTS ON A 200 WATT FORCED CONVECTION LIQUID HYDROGEN/DEUTERIUM TARGET. Williamson, K. D. Jr.; Simmons, J. E.; Edeskuty, F. J.; Fretwell, J. H.; Martin, J. T.; Ficht, H. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 21p. (CONF-730805-6). Dep. NTIS $3.25.

A forced convection target system is being developed for use at the Clinton P. Anderson Meson Physics Facility (LAMPF) which will produce neutrons by bombarding liquid deuterium with a proton beam via the process $p + d \rightarrow n + 2p$. The work described discusses the design and operating characteristics of a prototype unit designed to operate with a heat input of 200 watts. Data are presented on the operating characteristics of the unit using liquid hydrogen with heat disposition from both electrical heaters and from an electron beam of 25 MeV which has a time structure and intensity similar to that of LAMPF. Electron beam energy depositions of 25 W/cm^3 were achieved. Using data obtained on these tests a final target system has been designed and will be briefly discussed. (auth)

11385 (LA-UR-73-844) EXPECTATIONS AND PROBLEMS OF AN ON-LINE MASS SEPARATOR PROJECT ON A HIGH INTENSITY ACCELERATOR (LAMPF). Dropesky, B. J.; Erdal, B. R. (Los Alamos Scientific Lab., N. Mex.). 1970. Contract W-7405-eng-36. 10p. (CONF-730618-3). Dep. NTIS $3.00.

From 8th international Electromagnetic Isotope Separator Conference; Skovde, Sweden (12 Jun 1973).

A proposal for an on-line mass separator facility for the H^- beam (experimental area B) at the LAMPF linac is presented. The H^- beam is expected to be operated at 800 MeV and at a maximum intensity of 100 μA. The radioisotope production rates achievable in the target is studied by scaling up actual production data from ISOLDE (I) for mercury isotopes from a lead target 45.2 g/cm^2 thick irradiated with 30 nA of 600-MeV protons. The results are tabulated. A layout of the proposed facility is presented. (WHK)

11386 (SLAC-160) DESIGN AND OPERATION OF SLAC BEAMLINE 20-21-22. Winkelmann, F. C. (Stanford Linear Accelerator Center, Calif.). Apr 1973. Contract AT(04-3)-515. 122p. Dep. NTIS $5.45.

The design, properties, and operation of the SLAC Beamline 20-21-22 complex are described. Beamline 20, located in the End Station B area, has 250 kW power capability and contains two rf-separators. High quality $\pi^{\pm}$, $K^{\pm}$, p and $\bar{p}$ beams are provided at nearly all momenta up to 16 GeV/c, at repetition rates up to 180 pps. The beam has two branches (Beamlines 21 and 22) serving two different experimental areas. Both branches are well suited to wire chamber, counter, or rapid cycling bubble chamber applications which require high repetition rate separated beams with small phase space. (WHK)

11387 HOSPITAL-BASED SUPERCONDUCTING ACCELERATOR FACILITY FOR NEGATIVE π-MESON BEAM RADIOTHERAPY. Kaplan, H. S.; Schwettman, H. A.; Fairbank, W. M.; Boyd, D.; Bagshaw, M. A. (Stanford Univ., CA). Radiology; 108: No. 1, 159-172(Jul 1973).

A hospital-based negative π-meson radiotherapy facility is now being designed for Stanford University Medical Center. A 500-MeV electron beam from a superconducting linear electron accelerator will generate negative pions, which will then be directed by superconducting magnets through a novel 60-sectored pion channel, making possible simultaneous multiport irradiation. The pion channel design permits the magnetic field to be varied in time, and the number of sectors transmitting pions can be preselected and adjusted during treatment, thus providing maximal flexibility in shaping the "star region" of the beam to the continuously changing X-Y contours of the tumor while the patient, on a specially designed support assembly, is moved in the Z axis. (53 references) (auth)

11388 HIGH-LET RADIATION: CLINICAL FACILITIES AVAILABLE WITH NEUTRON BEAMS. Fowler, J. F. (Mount Vernon Hospital, Northwood, Eng.). Radiology; 108: No. 1, 139-143(Jul 1973).

A review of past and present clinical experience with high-LET radiation reveals that previous efforts at Berkeley, California failed to note that RBE of fast neutrons actually increases with decreasing size of dose per fraction, hence many patients were overdosed and work with fast neutrons was suspended for 20 years. The fast-neutron cyclotron now in operation at Hammersmith, England delivers 1440 rads in 12 fractions over 26 days (equivalent to 6300 rads of x rays in 30 fractions in 40 days) with no serious side effects. A review of available equipment, potential clinical advantages, and treatment centers throughout the world is given. (auth)

11389 NEW DESIGNS OF NEUTRON GENERATING TUBES. Bobrowski, C.; Korytowski, A.; Massalski, J. (Inst. of Nuclear Techniques, Krakow). Acta Phys. Pol.; A43: No. 5, 685-693(May 1973).

Two new designs of neutron tubes are discussed: a neutron tube with a hot cathode placed in an ion source on the side of a tritium target and a neutron tube with an ion source with a hot cathode shielded by a grid joined with the ion source cylinder. The systems used for the examination of tube characteristics are presented, together with a short discussion on the possibilities of practical application of the tubes. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 10917 and 11557.

11390 PARTICLE TRACK RECORD OF FRA MAURO. Hart, H. R. Jr.; Comstock, G. M.; Fleischer, R. L. (General Electric Research and Development Center, Schenectady, NY). Geochim. Cosmochim. Acta; Suppl. 3: 2831-2844(1972).

From 3rd lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 3).

Apollo 14 breccias show a mixture of high and low track densities at most interior positions, indicating that the majority of the tracks have been inherited from the parent ingredients of the breccias. Using the lowest of these track densities as indicative of maximum postbrecciation surface residence times, a median 1.35 m.y. is found, much younger than the less friable Apollo 11 and 12 igneous rocks. The igneous rock 14310 is studied as a part of a consortium, the results indicating a complex irradiation history. Soils are extremely variable, median track densities ranging over at least a factor of 200. Individual high-density soil grains yield track density gradients having variable slopes, most of which are lower than expected from the Surveyor III filter glass results. (auth)

11391 STUDIES BEARING ON THE HISTORY OF LUNAR BRECCIAS. Hutcheon, I. D.; Phakey, P. P.; Price, P. B. (Univ. of California, Berkeley). Geochim. Cosmochim. Acta; Suppl. 3: 2845-2865(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 3).

High-voltage electron microscopy of ion-thinned sections of breccias reveals details of substructure and radiation effects unobtainable by other techniques. Gas bubbles ~80 Å in diameter (originating in large part from solar wind implantation) and solar-flare tracks inherited from a prior irradiation are observed in fine (<5 μ) grains in 14301, 14315, 14318, 14311, and 14321, indicating that this material was once exposed on the surface as soil. The number density and visibility of the tracks, and the fraction of grains containing tracks and bubbles, decrease with the extent of metamorphism in the above order. Shock and recovery features in these rocks and in 15418 and 15086 are described. Large crystals have a different origin from the fine-grained material in matrix and clasts. Gradients of etched cosmic-ray tracks studied optically in the large breccias 14311 and 14321 are similar to the gradient in igneous rock 12022 and the absence of large scatter indicates that no tracks inherited from irradiation prior to breccia formation show up by etching. Lexan maps reveal the heterogeneity of the uranium distribution in most breccias. Uranium is primarily concentrated in interstitial sites. The density of fission tracks in whitlockite in 14321 is consistent with a ~$^2/_3$ contribution from ^{238}U and a ~$^1/_3$ contribution from ^{244}Pu, as would be expected if its age were the same as that of an igneous clast in 14321 (~3.95 Gy). (auth)

11392 TRACK STUDIES OF APOLLO 14 ROCKS, AND APOLLO 14, APOLLO 15, AND LUNA 16 SOILS. Berdot, J. L.; Chetrit, G. C.; Lorin, J. C.; Pellas, P.; Poupeau, G. (Museum National d'Histoire Naturelle, Paris). Geochim. Cosmochim. Acta; Suppl. 3: 2867-2881(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 3).

Results from track analysis are reported for rocks 14301, 14307, 14310, 14311, and 14321. Maximum surface residence times for rocks 14310 and 14321 are inferred to be $23 \pm 7 \times 10^6$ yr and $23 \pm 5 \times 10^6$ yr, respectively. The value for 14321 is similar to the rare-gas exposure age. Distributions of track densities are given for the soils 14163, 14259, 14141, 14148, 14149, 14156, 15071, 15081, and Luna 16 soil C-118, as well as percentages of track-rich fragments in the grain size 100 to 600 μ. A rough correlation is observed between the proportion of the track-rich fragments and the abundance of ^{36}Ar in bulk soils from four lunar sites, reflecting the fact that both high track densities in the centers of the grains ($\geq 10^8$/cm^2) and ^{36}Ar are acquired by the fines in the uppermost part of the lunar regolith. (auth)

11393 TRACK METAMORPHISM IN EXTRATERRESTRIAL BRECCIAS. Dran, J. C. (CNRS, Orsay, France); Duraud, J. P.; Maurette, M.; Durrieu, L.; Jouret, C.; Legressus, C. Geochim. Cosmochim. Acta; Suppl. 3: 2883-2903(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 3).

Nuclear particle tracks and various textural features stored in the constituent grains of the fine grained matrix of lunar and meteoritic breccias have been first studied by combined high voltage and scanning electron microscopies and then correlated to several characteristics of the breccias including their petrographic type, their scratch hardness, their rare-gas concentration, their albedo, and the density of microfractures in their constituent grains. The main purpose of this work was both to scale in temperature the heat metamorphism evolved during brecciation, and to evaluate the degree of "dust sintering" in the breccias. (WDM)

11394 RADIATION EFFECTS IN SOILS FROM FIVE LUNAR MISSIONS. Phakey, P. P.; Hutcheon, I. D.; Rajan, R. S.; Price, P. B. (Univ. of California, Berkeley). Geochim. Cosmochim. Acta; Suppl. 3: 2905-2915(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 3).

Optical and high-voltage electron microscopy were used to study radiation-produced defects. There is no systematic decrease in solar-flare track distributions in lunar fines even to a depth of 2.5 m. The soil gradually accumulates in thickness; stirring by impacts is usually on a small scale. The accumulation rate at Luna 16 site is far lower than at the Apollo sites; the mean track density in micron-size grains there exceeds ~10^{12}/cm^2; more than 90% of those grains are metamict; the Luna 16 site is at high longitude where electrostatic charging and transport of soil by geomagnetic tail electrons are minimal. A large fraction of soil grains on sloping ground have been isotropically irradiated, suggesting a tumbling downhill motion. Radiation exposure times of soils increase in the order: Fra Mauro trench bottom and Cone Crater soil; Apennine Front; Scarplet; Spur Crater; Mare Tranquillitatis and Oceanus Procellarum; Fra Mauro; Luna 16. Solar-wind gases quantitatively precipitate as ~80 Å gas bubbles at ~5000 atm pressure in soil grains. (auth)

11395 SOLAR FLARE AND GALACTIC COSMIC-RAY STUDIES OF APOLLO 14 AND 15 SAMPLES. Croazaz, G.; Drozd, R.; Hohenberg, C. M.; Hoyt, H. P. Jr.; Ragan, D.; Walker, R. M.; Yuhas, D. (Washington Univ., St. Louis). Geochim. Cosmochim. Acta; Suppl. 3: 2917-2931(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 3).

Thermoluminescence (TL) measurements in rock 14310 show a strong depth dependence consistent with that expected from solar flares. This effect should prove useful in studying solar-flare fluctuations in the time interval 10^2 to 10^5 years. Solar-flare track data in 14310 are similar to those previously measured and support the interpretation that the long term solar-flare spectrum for heavy nuclei can be represented by $dN/dE = KE^{-2.6}$. Rare-gas spallation ages for rock 14301, 14306, and 14311 are respectively 102 ± 30, 25 ± 2, and 661 ± 72 m. y. The 14306 value supports the idea that Cone Crater was formed 25 million years ago. Groupings of exposure ages suggest the dates of other major cratering events. Galactic track data in 14310 show little depth dependence. If the present cosmic-ray spectrum is accepted, this implies that solar flare produced ^{53}Mn ($T_{\frac{1}{2}} = 3.7 \times 10^6$ yr) should be undersaturated at the surface. Another possible interpretation is that galactic cosmic rays were more heavily modulated in the past at 1 AU. Different soil samples show very different irradiation histories. Track data in the coarse fraction of the Cone Crater sample suggest that this material has been relatively undisturbed since its formation. Track densities increase with decreasing grain size in a way that suggests that the small crystals were derived by micrometeorite bombardment of initially coarser grained material. The bottom of the trench appears lightly irradiated but this sample is something of a puzzle. All positions of the Apollo 15 deep drill are heavily irradiated. Combined with neutron data (Burnett et al., 1972), this shows that solar flares were active 5×10^8 years ago. (auth)

11396 CHARGE ASSIGNMENT TO COSMIC-RAY HEAVY ION TRACKS IN LUNAR PROXENES. Plieninger, T.; Kraetschmer, W.; Gentner, W. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Geochim. Cosmochim. Acta; Suppl. 3: 2933-2939 (1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 3).

Calcium is the first ion of which the total etchable range in pyroxenes has been measured by accelerator irradiations. It was found that energies of 2 MeV/amu are sufficient to produce total track lengths of about 4.5 μ in the interior of lunar pyroxene crystals. Direct comparison between the length distributions of cosmic-ray and Ca tracks in the same crystals shows coincidence

at the 4 to 5 μ peak. Investigations on the stability of 2 MeV/amu Ca and 1 MeV/amu Fe tracks in pyroxenes indicate that the shortening of tracks under lunar conditions is negligible, hence this peak may be ascribed to Ca. Length distributions, measured in pyroxenes from Apollo 11 igneous rock 10047,13 and Apollo 11 fines 10084,32 show four distinguishable peaks which are ascribed to even atomic numbers. This leads to an Fe peak situated at about 16 μ. The peak at about 12 μ is ascribed to unresolved Cr and Mn. If one takes into account the width of the peaks, an average abundance ratio (Cr + Mn)/Fe of 0.8 ± 0.4 results. (auth)

11397 TRACK CONSORTIUM REPORT ON ROCK 14310. Yuhas, D. E. (Washington Univ., St. Louis); Walker, R. M.; Reeves, H.; Poupeau, G.; Pellas, P.; Lorin, J. C.; Chetrit, G. C.; Price, P. B.; Hutcheon, I. D.; Hart, H. R. Jr.; Fleischer, R. L.; Comstock, G. M.; Lal, D.; Goswami, J. N.; Bhandari, N. Geochim. Cosmochim. Acta; Suppl. 3: 2941-2947(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 3).

Five different track laboratories each received a section running from the outside to the center of rock 14310. Data on the feldspars in individual sections, as well as sections exchanged between laboratories, are given here. In spite of the complications due to fission tracks, different laboratories generally obtain results that agree within the counting statistics. Solar-flare tracks confirm the PET orientation of the rock. The depth dependence of track density outside the solar-flare region is very flat, and is quite different than would be expected from prior studies of galactic cosmic rays. The tracks were apparently accumulated during the course of a complex irradiation history. (auth)

11398 THERMOLUMINESCENCE OF APOLLO 14 LUNAR SAMPLES FOLLOWING IRRADIATION AT −196°C. Blair, I. M. (Atomic Energy Research Establishment, Harwell, Eng.); Eddington, J. A.; Chen, R.; Jahn, R. A. Geochim. Cosmochim. Acta; Suppl. 3: 2949-2953(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 3).

The nonthermal leakage and saturation properties of the traps responsible for proton induced thermoluminescence in Apollo 14 lunar samples were studied. The data on leakage were consistent with a short term component of about an hour, together with a longer term, possibly constant, component. Saturation sets in at a dose of about 1.5 Mrad. The consequences of the findings for a possible explanation of the transient lunar phenomena are discussed. (auth)

11399 THERMOLUMINESCENCE OF APOLLO 12 SAMPLES: IMPLICATIONS FOR LUNAR TEMPERATURE AND RADIATION HISTORIES. Durrani, S. A. (Univ. of Birmingham, Eng.); Prachyabrued, W.; Christodoulides, C.; Fremin, J. H.; Edington, J. A.; Chen, R.; Blair, I. M. Geochim. Cosmochim. Acta; Suppl. 3: 2955-2970(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 3).

Thermoluminescence (TL), both natural and γ-ray induced, was studied in contingency fines 12070,112 and in powdered samples from the interior rock chip 12051,15, in the temperature range 20 to 600°C. In the natural samples glow peaks were observed at temperatures above ~300°C, those below having been thermally drained. Artificial irradiation introduced a prominent new peak at ~170°C, and enhanced those in the region 300 to 550°C. The growth of the high-temperature peaks with γ-ray irradiation was studied in order to deduce both the "natural (or equilibrium) dose" and the "half-dose" (needed to fill half the available "traps") for the samples. The TL parameters of the traps concerned were determined by the "initial rise" method. These data allowed the "effective temperature" of lunar storage (358 ± 10°K for the fines and 346 ± 5°K for the rock chip) and the radiation dose rates received (~30 rad/y within a factor of 3, and ~60 rad/y within a factor of 2, respectively) to be calculated for the samples. By considering the attenuation of the diurnal heat wave on the Moon, the mean subsurface depth of these samples was estimated (~0.5 cm for the fines, and ~2.5 cm for the rock chip). Other topics discussed include spectral analysis of TL glow, inhomogeneities in the distribution of TL phosphors, and temperature sensitization of samples. (auth)

11400 LUMINESCENCE OF LUNAR MATERIAL EXCITED BY ELECTRONS. Geake, J. E. (UMIST, Manchester, Eng.); Walker, G.; Mills, A. A.; Garlick, G. F. J. Geochim. Cosmochim. Acta; Suppl. 3: 2971-2979(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 3).

Luminescence emission spectra are shown for Apollo 14 fines and chips and for Apollo 15 fines, in comparison with the Apollo 11 and 12 material previously investigated. In all these materials the main luminescent constituent is plagioclase, which shows three main emission peaks, in the blue, green, and near ir, at about 4500, 5600, and 7800 A, respectively. The blue peak is probably caused by lattice defects. The green peak was previously ascribed to Mn^{2+} in Ca^{2+} sites; some evidence is now available that the ir peak may be due to Fe^{3+} in Ca^{2+} sites. Decay times of about 0.1 ms for the blue peak, 5 ms for the green peak, and 1.5 ms for the ir peak are consistent with these explanations. The ir peak is much weaker in lunar than in terrestrial plagioclase, possibly because most of the lunar iron is in the Fe^{2+} form. Luminescence emission photographs were taken, in color, of two Apollo 14 chips; these both showed only the characteristic plagioclase emission observed for the Apollo 11 and 12 chips. (auth)

11401 LUMINESCENCE OF APOLLO 14 AND APOLLO 15 LUNAR SAMPLES. Greenman, N. N.; Gross, H. G. (McDonnell Douglas Astronautics Co., Huntington Beach, CA). Geochim. Cosmochim. Acta; Suppl. 3: 2981-2995(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 3).

Luminescence measurements were made of Apollo 14 lunar samples with far uv, x-ray, and proton irradiation and of Apollo 15 lunar samples with x-ray irradiation. Preliminary efficiencies with the far uv are in the range 10^{-3} to 10^{-2}; efficiencies with x rays and protons are in the range 10^{-6} to 10^{-4}. The crystalline igneous rocks show higher efficiencies, in general, than the breccias and glasses, and the ratio of intensity of the green to the blue luminescence peak tends to be higher for the crystalline igneous rocks than for the breccias and glasses. Therefore, both the efficiency and the spectral character appear to have a systematic relationship to lithologic type (granitic versus gabbroic versus fragmental) and to geologic history and processes on the Moon (shocked versus unshocked or only mildly shocked material). (auth)

11402 THERMOLUMINESCENCE OF INDIVIDUAL GRAINS AND BULK SAMPLES OF LUNAR FINES. Hoyt, H. P. Jr.; Walker, R. M.; Zimmerman, D. W.; Zimmerman, J. (Washington Univ., St. Louis). Geochim. Cosmochim. Acta; Suppl. 3: 2297-3007(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 3).

The thermoluminescence (TL) response of typical bulk lunar fines is quite complex. The natural TL is produced by minor mineral constituents (typically less than 1 grain in 15). The low-temperature natural TL (around 200°C) is produced by a small fraction of the plagioclase grains, while the higher temperature TL is from grains rich in potassium and sometimes phosphorus. The dose rate on the Moon varies from grain to grain of a sample, because although all grains receive the same cosmic-ray dose rate, the internal dose rate from uranium and thorium varies significantly. Although the natural TL responds to the ambient temperature on the Moon, it appears that data of sufficient accuracy to measure, for example, the temperature gradient in deep core material cannot be obtained from bulk measurements but require separation of the samples into fractions with more homogeneous TL characteristics. The TL of bulk samples is however useful in estimating the average depth of lunar fines from near the surface. The stored TL is affected by white room light but is relatively unaffected by red light. (auth)

11403 SPECTRAL EMISSION OF NATURAL AND ARTIFICIALLY INDUCED THERMOLUMINESCENCE IN APOLLO 14 LUNAR SAMPLE 14163,147. Lalou, C. (CNRS, Gif-sur-Yvette, France); Valladas, G.; Brito, U.; Henni, A.; Ceva, T.; Visocekas, R. Geochim. Cosmochim. Acta; Suppl. 3: 3009-3020(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 3).

Using either colored glass filters or interference filters, the spectral emission of natural thermoluminescence of lunar fines and of ultraviolet and γ-induced thermoluminescence was studied. This analysis will probably be useful for further studies of lunar thermoluminescence as it may allow the differentiation of two types of thermoluminescence. (auth)

11404 ELECTRON COMPONENT OF COSMIC RAYS. II. Radiofrequency Emission of Relativistic Electrons in the Galaxy. Bulanov, S. V.; Dogel, V. A.; Syrovatskii, S. P. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 5, 653-663(1972).

Translated from Kosm. Issled.; 10: No. 5, 721-731(1972).

Spectra of the magnetic bremsstrahlung radio emissions in the directions pointing to the galactic pole and to the anticenter were calculated for compressed-halo models with the aid of space-energy distributions of electrons in the Galaxy arrived at in part I of the article. The characteristic parameters of the model are estimated from a comparison with observed background radio-frequency emission of the Galaxy. The spectral index of the

electron sources must be $\gamma_0 = 2.2$. Best agreement is obtained for a model in which the half-thickness of the halo is ≈1 kpc. In that model, the time it takes cosmic rays to escape from the Galaxy is $\approx 2.10^7$ years, and the average magnetic field intensity is $\sim 4.10^{-6}$ G. The model predicts the variation of the slope of the electron spectrum at the Earth in the E = 400 GeV energy range, with an increase of $^1/_2$ in the spectral index, so that $\gamma_e = 3.2 \pm 0.1$, and also the break in the spectrum of the secondary positrons at energy $E_1 \cong 3$ to 6 GeV, with the variation in spectral index up to the value $\gamma_{e+} \cong 3.1$ to 3.2 at $E > E_1$. (auth)

11405 MEASUREMENTS ON VARIOUS COMPONENTS OF THE AIR SHOWER. Boehm, E. Atomkernenergie; 20: No. 3, 187-188 (1972). (In German).

Experiments on air showers are reported that were performed or are planned to be carried out in Kiel. These experiments are concerned with the measurement of the muonic energy spectra for different distances from the center of the shower and with the measurement of horizontal air showers for the study of particle interactions above 10^{13} eV. The experiments are done with a magnetic spectrometer and with spark chambers for particle tracking. Momenta between 3 and 100 GeV/c can be detected using a sensitive area of 1 m^2. Experiments are planned to study the longitudinal development of air showers by detecting the Cherenkov light that is produced during the passage of the particles through the atmosphere. (GF)

11406 EVIDENCE OF THE EXTINCT NUCLIDE ^{146}Sm IN JUVINAS ACHONDRITE. Notsu, K. (Tokyo Univ.); Mabuchi, H.; Yoshioka, O.; Matsuda, J.; Ozima, M. Earth and Planetary Science Letters; 19: No. 1, 29-36(May 1973).

The search for the isotopic anomaly of Nd due to the disintegration of ^{147}Sm and ^{146}Sm was carried out on separated mineral phases of Juvinas achondrite. An internal isochron of 4.3 ± 2.5 billion years was obtained for ^{147}Sm–^{143}Nd pair. This provides the possibility of dating the planetary materials. Anomalies were observed for ^{142}Nd, giving the isotopic ratio ^{146}Sm/^{144}Sm at the time of solidification to be 0.39 ± 0.14. This is the first positive evidence of extinct ^{146}Sm which may be used as a p-process chronometer. (auth)

11407 ENERGY LOSSES OF GALACTIC COSMIC RAYS IN THE INTERPLANETARY MEDIUM. Urch, I. H.; Gleeson, L. J. (Monash Univ., Clayton, Australia). Astrophys. Space Sci.; 20: No. 1, 177-185(Jan 1973).

Using realistic models of cosmic-ray propagation in interplanetary space, the distribution in energy before entering the solar cavity and their mean energy loss were calculated for electrons, protons, and helium nuclei of a given energy near Earth. Interplanetary conditions appropriate for the epochs 1965 and 1969 were used. Cosmic-ray energies in the range of 20 to 1000 MeV/N were considered. (auth)

11408 INTERACTION OF FAST PARTICLES WITH MAGNETOHYDRODYNAMICAL TURBULENCE. Toptygin, I. N. (Leningrad Polytechnical Inst.). Astrophys. Space Sci.; 20: No. 2, 351-371(Feb 1973).

The acceleration of fast particles by Alfvén and magnetic sound waves of small amplitude is considered. The waves exist against the background of a strong, uniform magnetic field. The contributions to acceleration from a large scale random field (harmonics with $k < R^{-1}$, where R is the Larmor radius), as well as from a small scale field ($k > R^{-1}$) are taken into account. The small scale field was considered by perturbation theory, while large scale random field – in an adiabatic approximation. The energy dependence of the diffusion coefficient in momentum space, and the time of acceleration are estimated. The possible anisotropy of angular distribution is taken into account. If the Alfvén waves have spectral power index $\nu > 2$ and wave amplitude is small enough, then the energy dependence of the diffusion coefficient is stronger than in the case of the Fermi acceleration. For magnetic sound waves with $\nu \geq 2$ the energy dependance of the diffusion coefficient is the same as for the Fermi acceleration, but for $\nu < 2$ this dependance is less. The space diffusion coefficient of particles across the regular magnetic field is estimated. It is shown that this diffusion is due mainly to the large scale random field. (auth)

11409 MODULATION OF LOW ENERGY COSMIC RAYS. Sari, J. W. College Park, MD; Univ. of Maryland (1972). 126p. University Microfilms Order No. 73-11,412.

Thesis (Ph. D.).

Recent theories have related the propagation and diffusion of cosmic rays to the power spectrum of the interplanetary magnetic field. The power spectrum–diffusion coefficient relation at low energies (<100 MeV) is tested where the validity of the theories has been in doubt. A first order perturbation solution of the Fokker–Planck equation governing the diffusion, convection, and adiabatic deceleration of galactic cosmic rays in the solar medium is found to relate intensity fluctuations of low-energy cosmic rays to local changes in the propagation parameters. Diffusion coefficients are calculated from interplanetary magnetic field data obtained by Pioneer VI in 1965/1966. These are compared to simultaneous observations by IMP III of the proton flux in three energy channels (20 to 40, 40 to 60, 60 to 80 MeV). (TSS) (Diss. Abstr. Int., B)

Stars

11410 BETA CANIS MAJORIS STARS 15 CMa AND ξ^1 Cma. Shobbrook, R. R. (Univ. of Sydney). Mon. Notic. Roy. Astron. Soc.; 162: No. 1, 25-36(1973).

The Beta Canis Majoris variables 15 CMa and ξ^1 CMa were observed photoelectrically in yellow light during the 1971/72 season. 15 CMa shows random amplitude variations at its known period of 0.1845d; a re-discussion of earlier published photometry and radial velocities confirms this and also indicates that the period is variable, although the form of the variation cannot be determined. There may be other periodicities present, but this cannot be clearly ascertained from the data available. ξ^1 CMa, on the other hand, with a period of 0.2096d, showed a remarkably stable light curve shape during 1971/72, although earlier published photometry indicates that the curve may not always have had the same shape. The period is constant to about 1 s/century. 15 CMa is probably one of the least stable and ξ^1 CMa one of the most stable pulsators amongst the β CMa class of variable. (auth)

11411 CARBON ABUNDANCE AND COLOURS OF δ PAVONIS. Bell, R. A. (Univ. of Maryland, College Park). Mon. Notic. Roy. Astron. Soc.; 162: No. 1, 37-42(1973).

Willstrop's (Memo. R. Astr. Soc.; 69:83 (1965)) scanner observations of δ Pav show that the Swan bands of C2 are present in the spectrum of this star. Synthetic spectra calculations have been carried out, using different carbon abundances, and the carbon abundance of δ Pav, [C/H] = +0.45, obtained by matching observation and calculation. The influence of this enhanced carbon abundance, and the adopted value of the damping, on the UBV and uvby colours of δ Pav has been examined. The effect of enhancement of the carbon abundance on b-y and B-V is small whereas the influence of the damping constant is very important. (auth)

11412 NONRADIAL OSCILLATIONS AND CONVECTIVE INSTABILITY OF A POLYTROPE WITH A TOROIDAL MAGNETIC FIELD. Sood, N. K.; Trehan, S. K. (Panjab Univ., Chandigarh, India). Astrophys. Space Sci.; 19: No. 2, 441-467(Dec 1972).

The nonradial modes of oscillation, belonging to spherical harmonics of orders l = 1 and l = 3, of a gaseous polytrope with a toroidal magnetic field were investigated and it was found that a toroidal magnetic field increases the growth rate of convective instability for deformations belonging to the spherical harmonic l = 1 whereas it decreases the growth rate of convective instability for deformations belonging to the harmonics l = 2 and l = 3. The frequencies of the "acoustic" mode and the "Kelvin" mode are decreased by the presence of the toroidal magnetic field. (auth)

11413 EVIDENCE OF ORBITAL ECCENTRICITY FROM A NEW TWO-COLOR LIGHT CURVE OF MR CYGNI. Battistini, P.; Bonifazi, A.; Guarnieri, A. (Univ., Bologna). Astrophys. Space Sci.; 19: No. 2, 395-409(Dec 1972).

The circular elements of eclipsing binary MR Cygni in yellow and blue light are derived from both minima. The durations of eclipses are different and this is interpreted as an effect of orbital eccentricity. The elements deduced from one minimum and the depth of the other do not permit the construction of a theoretical light curve based on a spherical model which satisfies the other minimum. However, this might be feasible by introducing an appropriate value for the orbital eccentricity. New ephemeris are obtained from the photoelectric minima. (auth)

11414 PHOTON BUBBLES. Prendergast, K. H.; Spiegel, E. A. Comments Astrophys. Space Phys.; 5: No. 2, 43-50(1973).

The reason for this discussion of the nature of fluidized beds is that they qualitatively resemble a scattering atmosphere with radiation passing through from below. Because of this parallelism of the two situations the question is raised: Can one expect that bubbles of photons form and move up through a scattering atmosphere just as gas bubbles do in a fluidized bed? (WDM)

11415 COARSE ANALYSIS OF THE PECULIAR STAR 53 Aur. Zverko, J. (Astronomical Inst., Skalnate Pleso, Czech.). Bull. Astron. Inst. Czech.; 24: No. 2, 71-75(1973).

From the curve-of-growth analysis of the Ap star 53 Aur the anomalies of the chemical composition of the atmospheric layers

result. Lighter elements, such as Mg, Al, Si, and Ca seem to be deficient, the heavier ones are overabundant. From the most overabundant elements are: V in excess by a factor of 300, Sr by a factor of 1500, Y by a factor of 100, and rare earths by factors of hundreds to thousands. The effective temperature was adopted as 10,130°. The mean value of the ionization temperature is 9000°. The excitation temperature increases with the increasing ionization potential. The mean value of the electron density is log $N_e = 14.26$. The surface gravity established by the comparison of the observed and theoretical profiles of H_γ is log g = 4.0. The microturbulent velocity was adopted equal to zero. (auth)

11416 PHOTOELECTRIC PHOTOMETRY OF TX HERCULIS. Vetesnik, M.; Papousek, J. (Purkyne Univ., Brno). Bull. Astron. Inst. Czech.; 24: No. 2, 57-70(1973).

1728 photoelectric observations in B and 2070 in V color were carried out at the Brno Observatory in the years 1968, 1969, and 1971. Twenty new times of minimum light, derived on the basis of these observations, and new light elements, taking into account the periodic change of the basic period of the system, are presented. The anomalies of the light curve are discussed. The photometric orbital solution obtained is quite in agreement with those derived by the previous observers, and, together with Popper's spectroscopic orbit, numbers TX Her among the systems with the most reliably determined absolute dimensions. In addition the limb darkening coefficients for both components were successfully derived from the light curve. (auth)

11417 COMBINED OPERATIONS METHOD FOR TRANSFER PROBLEMS IN HOMOGENEOUS, CYLINDRICAL MEDIA. Kho, T. H.; Sen, K. K. (Univ. of Singapore). Astrophys. Space Sci.; 16: No. 1, 151-166(Apr 1972).

The problem of diffuse reflection by a homogeneous, isotropically scattering, infinite cylindrical medium was considered. The relevant auxiliary equation was formulated, the scattering function defined, and the integro-differential equation for such function deduced. For a medium having cylindrical distribution of source in addition to the incident flux at the outer surface, the integro-differential equation for the emergent intensity was established. (auth)

11418 ROTATING NEUTRON STARS: A MODEL FOR PULSARS. Grewing, M. (Univ., Bonn); Heintzmann, H. Z. Naturforsch.; 28a: No. 3-4, 377-382(1973).

A survey on the principal properties of neutron star matter and the models for neutron stars is given; those aspects that can be brought directly into agreement with pulsar observations are especially emphasized. (1 figure, 4 tables) (tr-auth)

11419 TEMPERATURE DEPENDENT NUCLEAR MASS AND ITS APPLICATION TO ASTROPHYSICAL PROBLEMS. Ohnishi, T. (Kyoto Univ.). Astrophys. Space Sci.; 20: No. 1, 225-239 (Jan 1973).

Temperature dependent nuclear binding energies are proposed. The binding energies for some 170 nuclides in $40 \leqq A \leqq 66$ are computed at several temperatures according to this model. The abundances of the nuclides in the above atomic mass region are then calculated for example by using these temperature dependent binding energies. It becomes clear that this type of binding energies makes the abundances of near closed-shell nuclides increased and/or the abundances of off-shell nuclides decreased. These binding energies can lead the more consistent theoretical abundances at least of the silicon-burning products than any ones calculated up to the present. (auth)

11420 SYNTHESIS OF CLOSE-BINARY LIGHT CURVES. IV. An Application to TX Ursae Majoris and MR Cygni. Hill, G.; Hutchings, J. B. (Dominion Astrophysical Observatory, Victoria, B. C.). Astrophys. Space Sci.; 20: No. 1, 123-148(Jan 1973).

A full description is given of the theory used in light curve synthesis, for binary stars showing various degrees of interaction. For strongly interacting pairs, an iterative mutual heating calculation is introduced. Detailed models are derived by these methods, and discussed, for the weakly interacting system TX U Ma and the strongly interacting system MR Cyg. A critical appraisal is given of this method of light curve synthesis and its results. (auth)

11421 SPECTRUM OF RR TELESCOPII IN 1968. Aller, L. H. (Univ. of California, Los Angeles); Polidan, R. S.; Rhodes, E. J. Jr.; Wares, G. W. Astrophys. Space Sci.; 20: No. 1, 93-110(Jan 1973).

The nova-like variable RR Telescopii observed at Cerro Tololo Observatory in 1968 displayed an unusually rich emission line spectrum ranging in excitation from Mg I to [Fe VIII]. A list of lines with their suggested identifications and approximate intensities covers the range from λ3100 to 6700. Only a semi-quantitative discussion is possible since photographic measurements of line intensities could not be calibrated photoelectrically. The spectrum can be interpreted as coming from a highly, inhomogeneous stratified shell illuminated by an extremely hot source. Radiation of Mg I [O I], [N II], and [S II] arises from dense pockets shielded from ionizing radiation. The [O III] and [Ne IV] radiation appears to originate in strata with densities of the order of 5×10^6 ions/cm^3 and a temperature of the order of 18000 K. The abundance of iron appears to be comparable with that of neon. The helium/hydrogen ratio may be about 0.24. (auth)

11422 ENERGY SPECTRUM OF He II IN A STRONG MAGNETIC FIELD AND BOUND–BOUND TRANSITION PROBABILITIES. Surmelian, G. L.; O'Connell, R. F. (Louisiana State Univ., Baton Rouge). Astrophys. Space Sci.; 20: No. 1, 85-91(Jan 1973).

The ground state energy of the He II (singly ionized helium) atom is determined in magnetic fields up to 10^{12} G. The 13 lowest excited states and bound–bound transition probabilities are calculated in magnetic fields from 10^7 to 10^9 G. (auth)

11423 RE-EXAMINATION OF GUM NEBULA. Beuermann, K. P. (Univ., Kiel). Astrophys. Space Sci.; 20: No. 1, 27-38 (Jan 1973).

A detailed analysis of interstellar measurements in the direction of the Gum nebula was carried out. The ionized region is shown to have an angular radius of ~18° and appears to be bounded by a shell of neutral gas. The mean electron temperature deduced from radio-frequency absorption measurements was found to be ≲8500°K. These parameters suggest that the nebula is the normal and possibly evolved H II region of ζ Pup and γ^2 Vel, rather than the fossil Strömgren sphere of the Vela supernova as suggested by Brandt et al. (1971). (auth)

11424 VARIABLE STARS IN THE GALACTIC CLUSTER NGC 6913. Bakos, G. A. (Astronomical Inst., Skalnate Pleso, Czech.). Bull. Astron. Inst. Czech.; 24: No. 3, 164-167(1973).

Photoelectric observations of eight bright stars of the galactic cluster NGC 6913 made during 1968-1972 are presented and the light variations of a number of stars discussed. One star, No. 6, appears to be a shell type variable and an additional 4 to 5 stars are suspected of variability. (auth)

11425 SPECTRUM VARIABILITY OF THE SHELL STAR 88 HERCULIS. Svolopoulos, S. N. (Univ. of Ioannina, Greece). Bull. Astron. Inst. Czech.; 24: No. 3, 167-169(1973).

Spectrophotometric data from spectra of 88 Her taken in September 1970 and in July 1971 are compared and the noticed differences summarized. (auth)

11426 C_2 IN ETA AQUILAE SPECTRUM. Bondal, K. R.; Joshi, G. C.; Pande, M. C. (Uttar Pradesh State Observatory, Naini Tal, India). Bull. Astron. Inst. Czech.; 24: No. 3, 169-170(1973).

The equivalent width of R_1 (16) line of the 0–0 band of the Swan system of C_2 calculated for the minimum phase of light variation in η Aql comes out to be 27 mÅ. Thus, if Dawe's model atmosphere and the assumed abundance are realistic, the lines belonging to the 0–0 band of Swan system of C_2 will be observable in the η Aql spectrum. (auth)

11427 OBSERVABILITY OF CO AND CO^+ IN ETA AQUILAE. Pande, M. C.; Joshi, G. C. (Uttar Pradesh State Observatory, Naini Tal, India). Bull. Astron. Inst. Czech.; 24: No. 3, 171-172 (1973).

The equivalent widths of the R(29) line belonging to 0–2 band of CO in η Aql were found to be 0.020 mÅ and 4.17 mÅ and of R(31) 0.019 mÅ and 3.71 mÅ at maximum and minimum phases, respectively. Thus, if Dawe's model atmospheres are realistic there is some chance of detecting the lines of the first overtone of CO near minimum phase of light variation in the star. (auth)

11428 DO BLACK HOLES EXIT? Cameron, A. G. W. (Yeshiva Univ., New York). Recherche (Paris); 4: No. 32, 215-222 (Mar 1973). (In French).

The lack of confirmation of the existence of the black holes predicted by theoretical physics is discussed. It is demonstrated that their discovery can only be made in an indirect manner: either by studying their effect on globular clusters, by establishing their presence as invisible companions to double star systems (several systems are suggested as possible candidates for this type of analysis: Epsilon Aurigae, HD 226868), or by resolving the missing mass problem in the galaxy clusters. (FR)

11429 FILAMENTARY STRUCTURE IN PLANETARY NEBULAE. Boeshaar, G. O. Columbus, OH; Ohio State Univ. (1972). 116p. University Microfilms Order No. 73-11,456.

Thesis (Ph. D.).

The filamentary structure of planetary nebulae was studied by means of photographic spectrophotometry in order to determine the characteristics of these features with respect to the ambient nebular gas. Untrailed spectrograms covering a wavelength range

of λ4800 to λ7400 were obtained for eight planetaries (IC 418, NGC 2392, NGC 2440, NGC 3242, NGC 3587, NGC 6543, NGC 6720, and NGC 6826) and microphotometer traces of these spectrograms were done in two modes. First, tracings of selected emission lines were made perpendicular to the wavelength dispersion. These yielded relative intensity vs. angular position contours of the nebulae for each line. Second, short slit traces along the dispersion were used to produce sets of relative emission line fluxes for the filaments and for the ambient gas. From these emission line fluxes, electron densities and temperatures were determined for the nebular regions studied. Filamentary regions show much stronger emission than does the surrounding nebular gas for the forbidden lines arising from nebular transitions of neutral and singly ionized atoms. The auroral lines of these species and the recombination lines of hydrogen show less striking enhancements. For the forbidden lines from more highly ionized states and for the recombination lines of neutral helium, fluxes from filamentary and from ambient gas regions are approximately equal. The recombination lines of ionized helium are weaker in filamentary zones than in the surrounding gas. In addition, the data show that the filaments are cooler and denser than their surroundings. Previously encountered ambiguities in electron density and temperature measurements, as well as difficulties with theoretical models, seem explainable in terms of such filamentary structure. Present photoelectric techniques (which give observations integrated over the entire planetary) appear inadequate for the study of these structural features. (Diss. Abstr. Int., B)

11430 INTERSTELLAR LINE SPECTRA OF ZETA OPHIUCHI AND ZETA PERSEI AND THEIR RELATION TO THE SHORT WAVELENGTH MICROWAVE BACKGROUND RADIATION. Bortolot, V. J. New York; New York Univ. (1972). 123p. University Microfilms Order No. 73-11,675.

Thesis (Ph. D.).

Thirty-one dispersion coudé spectrograms of ζ Oph and seven of ζ Per were numerically synthesized to produce high resolution, low-noise spectra in the interval λλ3650 to 4350 Å that yield more accurate data on atomic and molecular absorption in well-defined regions of the interstellar medium. The detection threshold is improved by as much as a factor 5 over single plates. Several new interstellar lines have been discovered in the ζ Oph − 15 km sec^{-1} cloud and the ζ Per + 13 km sec^{-1} cloud. (TSS) (Diss. Abstr. Int., B)

Quasi-Stellar, Radio, and X-Ray Sources

11431 (AD-754120) SEARCH FOR LAMBDA 21 cm ABSORPTION IN QSS AND OTHER SOURCES NEAR TO SPIRAL GALAXIES. Report No. 1972-14. Wright, M. C. H.; Gottesman, S. T. (Owens Valley Radio Observatory, Pasadena, Calif.). 1972. Contract N00014-67-A-0094-0019. 14p. NTIS.

Observations are described which attempt to detect lambda 21 cm absorption in the spectra of 3C 275.1, 3C 232, 3C 13, and 4C 29.03 which are within 2 Holmberg radii of Sc and Sb type galaxies. None was found to a limiting r.m.s. absorption of 1, 2, 1.5, and 2.5%, respectively, in a 21 km/s bandwidth. The regions around these sources have also been observed for lambda 21 cm emission. No line emission has been detected in the regions around 3C 232 and 3C 13, but emission detected from the Sc galaxy NGC 4651 gives an average HI surface density of 5.5×10^{20} cm^{-2} for the region including 3C 275.1. Adopting a model for the neutral HI distribution leads to a gas kinetic temperature that may be in excess of 18K. (auth)

11432 MECHANISMS OF OPTICAL, X-RAY, AND γ RADIATION FROM Crab PULSAR. Zheleznyakov, V. V.; Shaposhnikov, V. E. (Radiophysical Research Inst., Gorky, USSR). Astrophys. Space Sci.; 18: No. 1, 166-189(Sep 1972).

The synchrotron mechanism of radiation from the Crab pulsar was investigated on the assumption that the mechanism acts in a source moving with relativistic velocity round a neutron star. A detailed matching was made of the theoretical spectra of synchrotron radiation from relativistic electrons with the results of measurements of the radiation flux from the Crab pulsar in the infrared, optical, and x-ray ranges. The parameters of the radiating region (intensity of the magnetic field, source dimensions, density and lifetime of radiating electrons) were found. They are expressed through the δ ratio of the energy density of the magnetic field in the source to that of radiating electrons. The level of Compton γ radiation in this region is estimated. Possible values of δ at which the level will correspond to the available results of measurements of the γ-radiation flux from the Crab pulsar are given. An estimate is presented for the surface magnetic field of the neutron star which does not contradict those obtained from considerations of the magnetic flux conservation when compressing the object up to the neutron star dimensions. (auth)

11433 POSSIBLE MECHANISM RESPONSIBLE FOR THE DIFFERENTIAL ENERGY SPECTRUM OF RELATIVISTIC ELECTRONS AND NONLINEAR LOW-FREQUENCY SPECTRA OF COSMIC RADIO SOURCES. Braude, S. Ya.; Kaner, E. A. (Inst. of Radiophysics and Electronics, Kharkov). Astrophys. Space Sci.; 20: No. 1, 59-70(Jan 1973).

An explanation is suggested for the deviations from the power law which are observed in frequency spectra of discrete radio sources at decametric wavelengths. It is shown that a possible mechanism of the deviations is a combined effect of the stimulated and spontaneous scattering of relativistic electrons in the turbulent plasma of a source, as well as ionization energy losses thereof. The distribution function of the relativistic electrons, empirically established in an earlier paper (Braude et al., 1971) is derived from the kinetic equation. For a number of discrete sources the turbulence energy density and the plasma concentration are deduced with the aid of experimental data on low-frequency radio spectra. (auth)

11434 EFFECT OF STARK BROADENING IN THE RADIO RECOMBINATION LINE TEMPERATURES. Simpson, J. P. (Univ. of California, Berkeley). Astrophys. Space Sci.; 20: No. 1, 187-203(Jan 1973).

Observations of Orion A, M17, and W3 made at the National Radio Astronomy Observatory show Stark broadening in the α, β, and γ hydrogen recombination lines at 22 cm. Stark effect has such a large effect on the line profiles that fitted Gaussian profiles cannot be used to measure the area of the line. Theoretical line profiles have been derived from model H II regions. Voigt profiles fitted to the theoretical line profiles indicate that the areas of the lines derived from the fitted profiles may be systematically too small. Using Voigt profiles fitted by least squares to the observations, it is found that the line intensities at 22 cm agree with the intensity ratios predicted by LTE theory. (auth)

11435 LIMITING POLARIZATION OF RADIO WAVES. Grounds, S.; Ter Haar, D. (Oxford Univ.). Astrophys. Space Sci.; 20: No. 1, 39-42(Jan 1973).

The limitations of various expressions governing the determination of the limiting polarization of radio-waves are discussed and earlier work, which was limited to the case where the wave-vector is parallel to the density gradient, is extended to the special case where the magnetic field is parallel to the density gradient, but the wave-vector can be at an angle to both. The problem is considered in connection with the problem of pulsar emission. (auth)

Solar Phenomena

Refer also to abstracts 10956, 11561, and 11575.

11436 (AD−737850) DETECTION METHOD OF H 21-cm AND OTHER LINES IN THE RADIO SPECTRUM OF THE SUN. Final Scientific Report, 1 January 1967−30 June 1969. Noci, G. G.; Cantu, A. M.; Drago, F. G. C.; Mantellini, L. A. G. (Arcetri Astrophysical Observatory, Florence (Italy)). 1 Dec 1971. Contract F61052-67-C-0042. 68p. (AFCRL−72-103). NTIS.

The work essentially investigates the intensity of the hydrogen 3-cm and 21-cm lines in the solar spectrum. A form of the transfer equation suitable for the high precision required is found, together with a technique for avoiding, in its integration, the singularity at the turning point. The method followed to calculate the populations is described, and the transition rate coefficients are discussed. A model of the atmosphere is presented and the populations of the levels n = 1, $^2P_{\frac{1}{2}}$, $^2S_{\frac{1}{2}}$, $^2P_{\frac{3}{2}}$, n = 3, n = 4 of the hydrogen atom are found as functions of the height above the photosphere. The population equilibrium of the most important states in the chromosphere, in the transition region, and in the corona is discussed; and, finally, the intensity of the 3-cm line is calculated: it turns out to be too small to be detected. An analogous procedure, relative to the 21-cm line, is followed for a cold quiet prominence. (auth)

11437 (AD−753393) SPECTRAL DEVELOPMENT OF A SOLAR X RAY BURST OBSERVED ON OSO-7. Report for January−April 1972. McKenzie, D. L.; Datlowe, D. W.; Peterson, L. E. (Aerospace Corp., El Segundo, Calif.). 10 Nov 1972. 20p. (SAMSO-TR−72-288). NTIS.

The authors have made computer fits to proportional counter soft x-ray data and scintillation counter hard x-ray data for a small hard x-ray burst at UT 0519 on November 16, 1971. The energy content of the thermal plasma increased in conjunction

with a hard x-ray burst of 60-second duration which entirely preceded the 5-keV x-ray maximum. If x rays arise by thick target bremsstrahlung, the observed suprathermal electrons have sufficient energy to heat the thermally emitting plasma. In the thin target case, the collisional energy transfer from nonthermal electrons suffices only if the power law electron spectrum is extrapolated below 10 keV or the ambient plasma density exceeds 4×10^{10}/cc. (auth)

11438 (AD-754772) HEIGHT DISTRIBUTION AND DIRECTIONALITY OF 2 to 12 A X-RAY FLARE EMISSION IN THE SOLAR ATMOSPHERE. Progress Report. Catalano, C. P.; Van Allen, J. A. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Dec 1972. Contract N00014-68-A-0196-0003. 44p. NTIS.

The emission of soft x rays (2 to 12 A) in solar flares was studied in a new way by using simultaneous observations by two spacecraft near the Earth (Explorers 33 and 35) and another at a markedly different heliocentric longitude (Mariner V) during the 117-day period July 28 to November 21, 1967. Detailed intensity vs time observations on 607 separate flares were obtained. The principal findings are discussed in the report. (NTIS)

11439 (AD-755913) REVIEW OF SOLAR FLARE PHENOMENA. Bakshi, P.; Kalman, G. (Boston Coll., Chestnut Hill, Mass. Dept. of Physics). Apr 1972. Contract F19628-71-C-0078. 55p. (AFCRL-72-282). NTIS.

A review of the present picture concerning the solar flare events is presented. Optical, radio, x-ray, and particle spectra, their time-dependence and interrelations are discussed. A compilation of the chronology of the flare event is given. A flare model based on the recent work of Coppi and Friedland is analyzed with representative numerical data. The problem of the acceleration of protons to the very high energies observed is discussed and suggestions for new accelerating mechanisms resulting from strong plasma turbulence processes are put forward. (auth) (NTIS)

11440 (AD-755921) ACTIVE SUN UV SOLAR MODELS. Final Report, 1 November 1971-31 October 1972. Avrett, E. H. (Smithsonian Astrophysical Observatory, Cambridge, Mass.). Dec 1972. Contract F19628-72-C-0054. 16p. (AFCRL-TR-73-31). NTIS.

A unique computer program called PANDORA has been developed at the Smithsonian Astrophysical Observatory for the purpose of analyzing a wide variety of solar observational data to determine the temperature and density structure of quiet and active regions of the solar chromosphere. An extensive collection of euv solar data has been obtained from rocket and satellite experiments by members of the Harvard College Observatory, and the results are available for interpretation. The computer program was used to construct theoretical models consistent with the data. The resulting models provide information about the structure of the quiet chromosphere and some preliminary characteristics of the regions in which solar activity develops. (auth)

11 EVOLUTIONARY PROCESSES IN THE SOLAR SYSTEM. Colombo, G. (Univ., Padua). Phys. Earth Planet. Interiors; 7: No. 1, 1-8(Apr 1973).

Topics discussed include origin and evolution, aspects of evolution, particular dynamical configurations, mechanical evolutionary processes (tidal evolution collision, and close approach), and future prospects. (WDM)

11442 CORRELATION BETWEEN THE BRIGHTNESS OF COMETS AND FLUCTUATIONS OF THE SOLAR WIND. Dobrovol'skii, O. V.; Gnedin, Yu. N.; Novikov, G. G. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 5, 719-720(1972).

Translated from Kosm. Issled.; 10: No. 5, 791-792(1972).

The results of the observations of comet 1959 k by Liller in 1960 were analyzed. Liller observed this comet in the C_2 line (λ = 5165 Å). (WDM)

11443 FRONT THICKNESS OF INTERPLANETARY SHOCK WAVES. Ivanov, K. G. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 5, 714-715(1972).

Translated from Kosm. Issled.; 10: No. 5, 788-789(1972).

It is concluded that the interplanetary shock waves have extremely thick fronts, many times greater than the ion Larmor radii. (WDM)

11444 SOLAR COSMIC-RAY OF JULY 7, 1966 AND ITS MEASUREMENT BY PROTON-3 SATELLITE. Volodichev, N. N.; Galactinova, Yu. F.; Zel'dovich, M. A.; Kovrizhnykh, O. M.; Madeev, M. O.; Nechaev, O. Yu.; Savenko, I. A.; Slyusrev, Yu. T. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 5, 668-674 (1972).

Translated from Kosm. Issled.; 10: No. 5, 737-745(1972).

An examination was made of the solar cosmic-ray burst of July 7, 1966. Phenomena of solar activity and the geophysical effects accompanying the burst are described. Measurement results for streams of charged particles of different energies in the stratosphere and also on the satellites Explorer-33, OGO-3, Injun-4, and Proton-3 are cited. From the data of Proton-3's instruments, the integrated energy spectrum of protons over an energy range from 100 to 1000 MeV was computed for different times and from 500 to 2000 MeV at maximum intensity. The results of measurements, by Proton-3's DN-I and DN-II instruments, of streams of nuclei with $Z \geq 2$ and $Z \geq 20$ and energies $\gtrsim$500 MeV/N are cited. In the burst under consideration, the conclusion was reached that the fast particles with energies $\gtrsim$500 MeV/N consisted mainly of protons, while the nuclei with $Z \gtrsim 2$ and $Z \gtrsim 20$ with $E_Z \gtrsim 500$ MeV/N, when they were present, contributed substantially less than in the galactic cosmic rays. (auth)

11445 STRUCTURAL CHANGES AND REGULARITIES IN THE DISTRIBUTION OF CALCIUM FLOCCULAE ON THE SOLAR SURFACE IN THE COURSE OF CYCLE 19. Ambroz, P. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 2, 80-88(1973).

An analysis is presented of the longitudinal distribution of Ca II flocculae in the equatorial zone of ± 20 heliographic degrees. Using the method of photographic surface integration, the regularity of the distribution of the flocculae was investigated, considering various statistical centering. Simple linear dependences were found between the heliographic longitude of the flocculae and time. On smoothing the material considerably two longitudinal regions of preferred occurrence of Ca II flocculae, 180° apart with a recurrence of 27.2 days, became outstanding. Comparisons were made among the papers of Bumba and Howard (1969), Dodson and Hedeman (1968), Svestka (1968), Sykora (1971), and Vitinskij (1969), and the proportional effect of various methods of treatment on the results obtained was found. A periodic change in the distribution of the Ca II flocculae structure on the whole Sun was found with a mean period of 1.7 years. (auth)

11446 RELATION OF THE LARGE-SCALE DISTRIBUTION OF ACTIVITY ON THE SOLAR SURFACE AND OF THE FLUCTUATIONS OF SOME ACTIVITY INDICES IN THE COURSE OF CYCLE 19. Ambroz, P. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 2, 88-95(1973).

A comparison is presented of the pattern of the average surface density of Ca II flocculae, described by the index S, and of the fluctuations of some indices of activity (area of sunspots, relative number and area of prominences). Fluctuations of all studied indices with an average duration of 8 to 10 Carrington revolutions were found, and for certain intervals good mutual correlation was observed. By comparing the fluctuations of the activity indices with the development of the large-scale distribution of photospheric magnetic fields, a close relation was found between the development of supergiant regular structures and fluctuations of the activity indices. (auth)

11447 TRENDS OF DEVELOPMENT OF THE PROTON ACTIVE REGION OF JANUARY 24, 1971. Krivsky, L. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 2, 96-100(1973).

The development of the activity in the region where a proton flare occurred on Jan. 24, 1971, is represented with the help of the method of summation curves like with some of the proton regions in the past (Krivsky and Nestorov 1968, Krivsky 1969). This method, which fundamentally gives the trends in the release of energy of active regions for flares and x-ray bursts, can be used to characterize typical intervals in development, which display the same trend of development over a number of days. It is shown that the trends of all investigated parameters differ markedly at the time of the rotation with the proton flare and in the foregoing and subsequent rotations. (auth)

11448 SOLAR-FLARE GENERATED COSMIC RAY EMISSION OF JANUARY 24, 1971. Ilencik, J. (Inst. of Experimental Physics, Lomnicky Stit, Czech.); Krivsky, L. Bull. Astron. Inst. Czech.; 24: No. 2, 100-102(1973).

An analysis was made of the solar-flare generated cosmic-ray emission of Jan. 24, 1971 which caused the radioactivity of rocks on the Moon. The fundamental typical characteristics of the flare are given, including the Y-phase, the question of the directionality of the radiation is discussed, and the absorption length of the particles in the Earth's atmosphere, the rigidity exponent, the diffusion coefficient, the mean free path at 1 AU and the number of accelerated and ejected particles of the Sun are determined. (auth)

11449 EQUILIBRIUM OF HELICAL MAGNETIC STRUCTURES IN PROMINENCES. Sidlichovsky, M. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 2, 102-105 (1973).

A simple model for the formation of prominences through a pinch effect is proposed. The Lorentz force is a result of a twist-

ing of the coronal magnetic field with frozen plasma. The causes of the twisting were not investigated. They may due to a motion in the photosphere. A rough model of such twisted field (initially homogeneous) allows one to determine the final field configuration and a density distribution. The Lorentz force causes an increase of the mass density near the axis of the twisting. This is connected with radiative cooling, and the plasma becomes visible in Hα as a quiescent prominence with a helical structure. The temperature changes do not influence the results of isothermal twisting, since the dynamical equilibrium is governed by magnetic forces, and pressure forces turn out to be unimportant. The magnetic field is therefore nearly force-free. (auth)

11450 OCCURRENCE OF AURORAE IN THE COURSE OF THE 11-YEAR SOLAR CYCLE. Pokorny, Z. (Astronomical Observatory, Prostejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 2, 107-108(1973).

The method of superposition was used to investigate the occurrence of aurorae in the course of the 11-year solar cycle. By analyzing data from the years 1897–1951, obtained from the Yerkes Observatory, it was found that aurorae occur most frequently during year + 2 following the maximum of the relative sunspot number. In connection with the two-maxima dependence of the occurrence of proton and similar events on the Sun, which have a considerable effect on geophysical phenomena, it is shown that the second maximum is larger from the point of view of energy than the maximum occurring roughly at the same time as the maximum of the relative sunspot number. (auth)

11451 PERIODICITY OF LARGE SUNSPOT GROUPS. Kopecky, M. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 3, 113-118(1973).

The periodicity of sunspot groups with an average area larger than 500 millionths of the solar hemisphere surface and of sunspot groups with the maximum area larger than 1500 millionths is studied. Their 11-year period, the double maximum of the 11-year period according to Gnevyshev, the "butterfly" diagrams and the long period of the sunspots are studied. This study does not result in any special regularity of the occurrence of large sunspot groups which would allow one to forecast the occurrence of the great active regions on the Sun. (auth)

11452 HEIGHT GRADIENT OF THE CORONAL EMISSION LINE 5303 A. Rusin, V. (Astronomical Inst., Skalnate Pleso, Czech.). Bull. Astron. Inst. Czech.; 24: No. 3, 121-129(1973).

The data of surface photometry, obtained from the spectrograms of the coronal station at Lomnický Štít, over the period 1966–1971, is treated. If the gradient is determined from the relation $G = \Delta(\log I)/\Delta h$, its magnitude fluctuates in relatively wide limits and differs considerably from the values, obtained by other authors. It was found that this wide scale of gradient values is not random, but that it corresponds to the different degrees of solar activity and their manifestations in the solar corona. With a view to this, one can divide the gradient into three groups: calm, active, and very active. The disadvantage of determining the gradient according to the relation mentioned above, is that it only holds true for a linear decrease of the intensity, which in this case does not apply to all investigated cases, and even if it holds, it does so only for a certain small part of the curve (if it is linear), i.e., not for its whole. From this point of view there exists the possibility of dividing the curve of intensity decrement into three parts: two linear (large gradient in the region of 40 in. to 4 ft. and a small gradient in the region of more than 5 ft.), and the intermediate region between them. (auth)

11453 SEASONAL VARIATIONS OF SOLAR ACTIVITY. Ambroz, P. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 3, 130-132(1973).

A statistical study is presented of the fluctuation of monthly average values of the relative sunspot number. It was found that fluctuations with half-periods in intervals of 120 to 140 and 180 to 200 days occur most frequently. The latter interval shows that some of the fluctuations are repeated nearly exactly after one year. It is shown that they may be incorrectly interpreted as the "annual variations" of the solar activity. It is also shown that their pattern (i.e., the positions of the maxima and minima of the fluctuations with respect to the season of the year) is not time persistent and, therefore, that the dependence, described as the annual variation of solar activity, cannot be applied in long-range forecasts of solar activity. (auth)

11454 PHYSICAL RELATION BETWEEN THE MAGNETIC FIELD AND THE BRIGHTNESS IN THE SUNSPOT UMBRAE. Abdussamatov, H. I. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 3, 118-120(1973).

From measurements of brightness and magnetic field intensity in umbrae of three sunspots the physical relation of both quantities is demonstrated. (auth)

11455 TEST FOR DETECTION OF FINE STRUCTURE OF THE SOLAR WIND VELOCITY. Lotova, N. A.; Chashey, I. V. (Lebedev Inst. of Physics, Moscow). Astrophys. Space Sci.; 20: No. 1, 251-262(Jan 1973).

A new method of search and analysis of the fine structure in the velocity of interplanetary plasma irregularities is developed. (auth)

11456 POPULATIONS OF QUANTUM LEVELS OF HYDROGEN ATOMS IN CHROMOSPHERIC FLARES. Kurochka, E. V.; Kurochka, L. N. (Kiev State Univ.). Bull. Astron. Inst. Czech.; 24: No. 3, 132-136(1973).

It is shown that the relative population of the hydrogen atom levels cannot be used to determine the electron temperature in the flares. This is linked with the fact that the level population ratios are determined mainly by the optical thickness in the hydrogen lines. The problem of the overexcitation of the levels of hydrogen atoms in the flares which occurs only at low values of the optical thicknesses, was also solved. (auth)

11457 ABSENCE OF THE PHILLIPS BANDS IN THE SOLAR PHOTOSPHERIC SPECTRUM. Sinha, K. (Uttar Pradesh State Observatory, Naini Tal, India). Bull. Astron. Inst. Czech.; 24: No. 3, 136-138(1973).

The absence of Phillips bands in the solar photospheric spectrum and the presence of Swan bands seem to point to a non-LTE path for the formation and disappearance of C_2 molecules in the solar photosphere. (auth)

11458 MOLECULAR ABUNDANCES IN SUNSPOTS. Gaur, V. P.; Pande, M. C.; Tripathi, B. M. (Uttar Pradesh State Observatory, Naini Tal, India). Bull. Astron. Inst. Czech.; 24: No. 3, 138-143(1973).

The results of the dissociation equilibrium calculations for Zwaan's sunspot model are given. It appears that many di- and tri-atomic molecules form in sufficient abundances in the spots. It is suggested that for assessing the differences between the physical conditions of various sunspot models the locations of various molecules on the average geometrical depth of formation versus temperature (at that depth) curve can serve as a theoretical criterion. (auth)

11459 INTERACTION BETWEEN THE INTERSTELLAR MEDIUM AND SOLAR WIND PLASMA. Wallis, M. K. (Royal Inst. of Tech., Stockholm). Astrophys. Space Sci.; 20: No. 1, 3-18 (Jan 1973).

The interaction processes governing the penetration of the interstellar gas into the solar neighborhood are re-examined—as well as photo-ionization and charge-exchange processes, proton elastic collisions and electron ionizations help reduce the nearby gas densities. The total destruction rate varies little during the solar cycle, by perhaps 10%. Particle heating, particularly via the elastic collisions, determines the gas characteristics in the gravitationally focussed tail—enhanced H-density is prevented, while the He-tail is effectively hotter than 10^5K. Termination of the solar wind is rediscussed in the light of both electron heating and the stronger gas/plasma interaction. The spiral interplanetary field is taken to break up and the subsonic plasma flow to be controlled by the pressure of slowly cooling electrons. The terminating collisionless shock is then, if it exists at all, very weak ($M_1 < 1.4$), subcritical, and energetically unimportant. Cosmic rays are little affected by this sonic transition, but at least the electron component should be modulated by plasma turbulence throughout the ionizing flow. (auth)

11460 SOLAR-WIND CYCLE, THE SUNSPOT CYCLE, AND THE CORONA. Hirshberg, J. (Ames Research Center, Moffett Field, CA). Astrophys. Space Sci.; 20: No. 2, 473-481(Feb 1973).

Recent theories of the solar cycle and of coronal heating strongly suggest that solar cycle variations of different quantities (i.e. sunspots, coronal green line, etc.) ought not to be expected to be in phase with one another. In agreement with this notion it is noted that the shape of the corona typical of a "maximum" eclipse occurs 1.5 yr before sunspot maximum, compared with 2 yr as might be expected from Leighton's "standard" model. Further, it is argued that the phase of the solar wind cycle can be determined from geomagnetic observations. Using this phase, a solar cycle variation of 100 km s^{-1} in the solar-wind velocity and 1 γ in the magnetic field intensity becomes apparent. In general, the solar-wind cycle lags the coronal-eclipse-form cycle by 3 yr, compared with the 2 yr that might be expected from model calculations. (auth)

11461 NOTE ON THE SOLAR-WIND HEATING (TWO FLUID MODELS). Research Note. Cuperman, S. (Univ. of Colorado, Boulder). Astrophys. Space Sci.; 20: No. 2, 519-520(Feb 1973).

For completeness and to enable an objective evaluation of the Cuperman and Harten (1971a) nonconventional two-fluid model of the solar wind, more recent results are presented which were

obtained with this model under boundary conditions comparable to those of the models of Barnes et al (1971) and Wolf et al (1971). (WDM)

11462 PIONEER 9 ELECTRIC FIELD EXPERIMENT. III. Radial Gradients and Storm Observations. Scarf, F. L.; Green, I. M.; Burgess, J. S. (TRW Systems Group, Redondo Beach, CA). Astrophys. Space Sci.; 20: No. 2, 499-507(Feb 1973).

A detailed analysis is presented of the Pioneer 9 vlf electric field observations for 20 selected storm periods covering a heliocentric range extending from 0.754 AU to 0.99 AU. Although data from only two low-frequency channels are available, the results of the present study tend to confirm the preliminary speculation by Scarf and Siscoe (1971) that the turbulent E-field spectrum in the disturbed solar wind has a significant radial gradient. (auth)

11463 WAVE-TRAINS IN THE SOLAR WIND. Olbers, D. J. (Univ., Hamburg); Richter, A. K. Astrophys. Space Sci.; 20: No. 2, 373-389(Feb 1973).

The main results of Whitham's averaged Lagrangian method for the treatment of linear wave-trains in a weakly inhomogeneous, moving medium are presented briefly. This method is then applied to an ideal, isotropic, one-fluid plasma which can be taken for the lowest order approximation for the interplanetary solar-wind expansion. (auth)

11464 MULTI-ION PLASMAS IN ASTROPHYSICS. I. General Requirements for the Existence of Critical Points. Weber, E. J. (Kitt Peak National Observatory, Tucson, AZ). Astrophys. Space Sci.; 20: No. 2, 391-400(Feb 1973).

The steady-state motion of a quasi-neutral n-ion plasma is investigated using a fluid-dynamical model. The main results obtained are that there are only two distinct ways in which such a plasma can make a transition from a subsonic state to a supersonic one. There is one unique possibility for which there exists one critical point where all the ion gases have their Mach numbers exactly to unity and where the individual ion forcing functions (the inhomogeneous terms) are non-zero but linearly related to each other. The other possibility is that at a critical point all inhomogeneous terms are identically equal to zero and there exist as many critical points as there exist simultaneous zeros of the ion forcing functions. These results are necessary and sufficient for $n \geq 3$. For one- and two-ion plasmas special results can be obtained, some of which fit into the above two classes and some of which do not. (auth)

11465 MULTI-ION PLASMAS IN ASTROPHYSICS. Weber, E. J. (Kitt Peak National Observatory, Tucson, AZ). Astrophys. Space Sci.; 20: No. 2, 401-415(Feb 1973).

An isothermal hydrodynamic model of the motions of a multi-ion plasma in a gravitational field is developed and the properties of the flow are discussed for the case of major astrophysical interest in which the gas undergoes a subsonic–supersonic transition. It is shown that the existence of critical points through which the plasma has to pass will determine a large number of the plasma parameters, especially the temperature of the minor ions. The equation of motion of a two ion gas (hydrogen–helium) are solved numerically and yield the interesting result that the bulk velocity of the plasma constituents are not equal at 1 AU. (auth)

11466 PROPAGATION OF ALFVÉN WAVES AND THEIR DIRECTIONAL ANISOTROPY IN THE SOLAR WIND. Voelk, H. J.; Aplers, W. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). Astrophys. Space Sci.; 20: No. 2, 267-285(Feb 1973).

The propagation of solar Alfvén waves in interplanetary space is studied in the approximation of geometrical optics. Ray paths and the change of wave vectors and amplitudes along the rays are determined assuming an Archimedean-spiral interplanetary magnetic field. In particular, the Alfvénic fluctuations in the 2 directions perpendicular to the magnetic field direction are calculated under the assumption that the Alfvén waves are produced at the Sun and emitted with an isotropic directional distribution from a reference level close to the Sun. It turns out that due to the combined effect of spherical expansion of the solar-wind flow and the spiralling of the interplanetary field the magnetic fluctuations in the direction perpendicular both to the unperturbed field and the radial direction have much more power than in the other directions (directional anisotropy). The results are compared with spacecraft observations made by Belcher and Davis (1971), that show an anisotropy of a similar character. It is argued that under average conditions the physical process leading to an anisotropy is not selective coupling of Alfvén waves into compressional waves, as suggested by Belcher and Davis, but rather the above mentioned dissipationfree effect of geometrical optics. Finally, arguments are presented to explain the discrepancy between the calculated high anisotropy and the measured low anisotropy in terms of finite amplitude effects and wave-scattering. (auth)

Galaxies

11467 (AD-751033) GAMMA RAY EMISSION FROM THE REGION OF THE GALACTIC CENTER. Cosmic Physics Report. Dahlbacka, G. H.; Freier, P. S.; Waddington, C. J. (Minnesota Univ., Minneapolis. School of Physics and Astronomy). Sep 1972. Contract N00014-67-A-0113-0021. 22p. NTIS.

A combination nuclear emulsion–spark chamber gamma-ray (E > 100 MeV) telescope was used to study the region of sky that includes the galactic center. 95% confidence upper limits on the flux from the reported sources G γ2 + 3 and Sgr γ-1 were placed at 4.4 and 8.8×10^{-5} protons/cm^2-sec, and a similar limit on the emission from the galactic center as a point source (±0.75°) was placed at 3.3×10^{-5} protons/cm^2-sec. No enhanced emission was observed from the galactic plane (±6°) and an upper limit of 2×10^{-4} protons/cm^2-sec rad was obtained. (auth) (NTIS)

11468 (AD-754078) HIGH RESOLUTION NEUTRAL HYDROGEN STUDY OF THE GALAXY M 51. Report No. 1972-13. Weliachew, L.; Gottesman, S. T. (Owens Valley Radio Observatory, Pasadena, Calif.). 1972. Contract N00014-67-A-0094-0019. 34p. NTIS.

A 2 arc min synthesis study of the spiral galaxy M51 (NGC 5194) has been made in the lambda 21 cm emission line of neutral hydrogen. A morphological H I symmetry axis is found at a position angle of 22° while the dynamically determined major axis is found at a position angle of −8°. The velocities in the north-east outer spiral structure are found to be strongly noncircular. They agree in magnitude with predictions made by Toomre and Toomre for the tidal interaction between M51 and its companion galaxy NGC 5195. A possible continuation in neutral hydrogen of the outermost south-west spiral arm has been detected. M51 also exhibits a strong deficiency in H I surface density at its center. An upper limit of 10 billion solar mass units per beam area has been placed on the neutral hydrogen content of the companion galaxy NGC 5195. This, in turn, yields an upper limit of about 0.1 for the distance-independent ratio M (H I)/L (pg). (auth) (NTIS)

11469 (AD-754079) 327 MHz OBSERVATIONS OF THE GALACTIC CENTER: POSSIBLE DETECTION OF A DEUTERIUM ABSORPTION LINE. Report No. 1972-16. Cesarsky, D. A.; Moffet, A. T.; Pasachoff, J. M. (Owens Valley Radio Observatory, Pasadena, Calif.). 1972. Contract N00014-67-A-0094-0019. 18p. NTIS.

The spectrum of radiation from the galactic center in the vicinity of the deuterium ground-state hyperfine transition was observed. With about 100 hours of observing time the spectrum shows r.m.s. fluctuations about 7×10^{-5} of the on-source power level. An absorption feature at 327.38837 ± 0.00001 MHz (corrected to the local standard of rest) has a depth of 2×10^{-4} of the continuum level. This feature is probably the deuterium line at v (LSR) + −3.7 km/s. A discussion is included of the abundance of interstellar deuterium relative to hydrogen and of the difficulties in calculating it. Uncertainties include the optical depth of the corresponding hydrogen absorption line, which is saturated, and the distribution of absorbing clouds. (auth)

11470 (AD-754121) SURVEY OF ELLIPTICAL GALAXIES AT 6 cm. Report No. 1972-15. Ekers, R. D.; Ekers, J. A. (Owens Valley Radio Observatory, Pasadena, Calif.). 1972. Contract N00014-67-A-0094-0019. 26p. NTIS.

The results are reported of a 6 cm radio continuum survey of 191 E and SO galaxies with known redshifts. Nineteen galaxies were detected. These were reobserved at higher resolution and could be divided into well separated classes of compact and extended sources. The extended emission was found only in giant E galaxies whereas the compact radio sources were also found in less luminous E galaxies. This may affect the use of radio galaxies as standard candles in cosmology. The presence of optical emission lines is well correlated with compact radio emission. The possibility that the SO galaxies detected are in fact misclassified E or D galaxies is discussed. (auth) (NTIS)

11471 DETERMINATION OF THE MASS OF THE GALAXY USING THE DENSITY WAVE MODEL OF THE SPIRAL ARMS. Basu, B.; Roy, A. K. (Jadavpur Univ., Calcutta). Bull. Astron. Inst. Czech.; 24: No. 2, 76-79(1973).

The mass of the Galaxy was calculated from a simple relation obtained from the study of the density wave model of the spiral arms. Using Schmidt values of the circular velocities outside 3 kpc from the center and lower values inside and his value of the surface density of $114 \cdot M_\odot\,pc^{-2}$ at $R = R_\odot$, the values for the surface density was calculated along the entire radius of the

Galaxy with the help of a simple formula derived in the density wave solution. The resulting mass was 2.1×10^{11} $M_\odot$, which seems to be a quite reasonable value for the mass of the Galaxy. The galactic mass has been determined previously by many different models by various authors. Some of these masses agree well with the present value. The discrepancy does not exceed 20% in these cases. The procedure can probably be applied also to determine the masses of some other nearby spirals. (auth)

11472 DETERMINATION OF THE INFRARED (45 TO 500 μM) EMISSION SPECTRA OF THE SKY USING AN INTERFEROMETER ON BOARD AN AIRCRAFT. Baluteau, J. P. (Centre National de la Recherche Scientifique, Verrieres-le-Buisson, France); Boussoletti, E.; Langlet, A.; Roucher, J. ELDO/ESRO Sci. Tech. Rev.; 4: No. 4, 353-369(1972). (In French).

Spectral emission measurements were made from a Caravelle 116 aircraft of the Centre d'Essais en Vol (Bretigny, France). The measurements were made in view of detecting lines due to interstellar matter. Two spectra recorded during the night of the 8th of May 1972 at a height of 11.2 km are presented. A spectral resolution of 0.18 cm^{-1} was obtained. A spectral range of between 25 and 200 cm^{-1} was covered, the region beyond 125 cm^{-1} being observed for the first time. Water vapor lines were observed together with other lines due to mirror atmospheric components. Some of these latter lines were identifiable. (FR)

11473 REAPPRAISAL OF SEVERAL EXTENSIVE PHENOMENA OF THE HIGH GALACTIC LATITUDES. Elliott, K. H.; Meaburn, J. (Univ. of Manchester, Eng.). Astrophys. Space Sci.; 20: No. 1, 111-112(Jan 1973).

The relationships between the diffuse and filamentary gaseous nebulosity, the giant radio loops, and the high, medium, and low velocity neutral hydrogen are considered in the light of recent observations. The existence of other giant loops is also suggested. (auth)

11474 STRUCTURE OF PECULIAR GALAXIES. Sersic, J. L. (Observatorio Astronomico, Cordoba, Argentina). Bull. Astron. Inst. Czech.; 24: No. 3, 150-157(1973).

The dynamical problem of the motion of a test particle in a gravitational field of variable mass is studied to explain some properties of galaxies. A general potential is reduced to one with axial symmetry and the properties of singular regions and points of the equipotentials are studied for this potential. The theoretical results are used to give an interpretation of some appearances of peculiar objects (ejection of massive bodies from galaxies, the existence of an annular structure, etc.). (auth)

11475 ^{187}Re, RECYCLING R-PROCESS ELEMENTS THROUGH STARS, AND THE AGE OF THE GALAXY. Talbot, R. J. Jr. (Inst. of Theoretical Astronomy, Cambridge, Eng.). Astrophys. Space Sci.; 20: No. 1, 241-249(Jan 1973).

The enhanced β-decay rate of ionized ^{187}Re in stars was studied within the context of a detailed numerical model of the production of r-process elements and their recycling through stars during the course of galactic evolution. It was concluded that the enhanced decay rate does not significantly reduce the Re–Os chronometer age for the Galaxy. Consequently, the ^{187}Re β-decay half-life and the neutron cross-section ratio $\sigma(^{186}Os)/\sigma(^{187}Os)$ remain as the significant uncertainties in this chronology. Unlike the uncertainties in other chronologies, both are amenable to laboratory measurements. (auth)

11476 SIMPLE MODEL OF THE GALAXY WITH A LOGARITHMIC DENSITY LAW. Basu, B.; Saha, G. (Jadavpur Univ., Calcutta). Bull. Astron. Inst. Czech.; 24: No. 3, 157-161(1973).

A model of the Galaxy based on the logarithmic density law was constructed. The potential and attraction in the plane of symmetry were calculated, and the circular velocities deduced at different distances from the center. The volume and projected densities were obtained at different distances and the total mass evaluated. The total mass obtained in the model was lower than those of the other models constructed by various authors, but the discrepancy was not very great. It is suggested that the new density law may yield better results if more comprehensive models involving superposition of several elementary bodies are constructed. (auth)

11477 EXTINCTION AND SCATTERING BY SEVERAL TYPES OF SILICATE SPHERE OF RADIUS 0.05 TO 1.0 μM, FOR THE WAVELENGTH RANGE 0.21 TO 50 μM. Bromage, G. E. (Royal Observatory, Edinburgh); Nandy, K.; Khare, B. N. Astrophys. Space Sci.; 20: No. 1, 213-224(Jan 1973).

An exact calculation of scattering and absorption by various submicron sized silicate spheres is presented, using accurately determined optical constants in the wavelength range from 50 μm to 0.21 μm. The extinction features near 10 μm and 20 μm for various samples are discussed. It is found that the ratio of peak extinction at 20 μm to that at 10 μm is constant for small particles up to r = 0.4 μm, but is less for particles of radius 1 μm. The ratio of maximum extinction in the ultraviolet to that at 10 μm decreases with increasing particle size. (auth)

11478 THIRD INTEGRAL OF MOTION IN A SYSTEM WITH A POTENTIAL OF THE FOURTH DEGREE. II. RESONANCE CASE 1:2. Andrle, P. (Astronomical Inst., Prague). Bull. Astron. Inst. Czech.; 24: No. 3, 161-164(1973).

Assuming that a steady-state galaxy possesses a plane and an axis of symmetry and that its potential is a polynomial of the fourth degree, the first approximation to a formal third integral was found in terms of Weierstrassian elliptic functions (Andrle, 1966). Higher approximations can only be derived for some resonances of the periods of the two relevant elliptic functions in a simple form. The case leading to the resonance 1:2 in real periods and 1:1 in imaginary periods is treated in greater detail. (auth)

11479 SPECTROSCOPIC STUDY OF GALACTIC NUCLEI. Warner, J. W. III Columbus, OH; Ohio State Univ. (1972). 126p. University Microfilms Order No. 73-11, 602.

Thesis (Ph. D.).

The scope of activity in the nuclei of normal galaxies and its relation to more energetic objects like quasi-stellar sources has provoked considerable interest in recent years, yet few galaxies have been studied in any detail since adequate instrumentation has not been available. In this thesis several nearby objects (M51, M81, NGC 5195) are singled out for a detailed study of their inner nuclei using image tube spectrographic techniques. Widened spectra are obtained using a skylight suppressor on the slit of the spectrograph and various slot sizes. Line strengths are shown to vary as a function of distance from the nucleus with [NII]λ6584/Hα changing by an order of magnitude in M51. For M51 and M81 physical conditions are calculated and compared for concentric regions surrounding the nucleus, and it is shown that there is a density gradient in the ionized gas going into the nucleus. From an analysis of the emission line strengths, either nitrogen and sulfur are over-abundant to a larger extent than previously thought, or large amounts of absorption exist internal to the nuclei and a temperature gradient exists, or partial ionization regions play a very important role in nuclei. It is thought that ionization changes do not cause the change in [NII]/Hα with distance from the nucleus. Using equivalent widths and continua of standard spectral types and similar measured quantities for M51 and NGC 5195 models of the stellar populations in these galactic nuclei are calculated. Both objects are fit best with a combination of early and late type stars, yet neither can be fit well. Clearly super metal rich stars and/or interstellar line absorption must be taken into account for NGC 5195. For M51 possibly the effects of continuous interstellar absorption and thermal continuum must be studied. A summary of all known data is given for several galactic nuclei and an idealized composite model is detailed. This is then compared to the characteristics of more active objects of galactic mass. It is seen that differences are mainly a matter of power levels. Similar but heightened activity exists in quasi-stellar sources and Seyfert nuclei. (Diss. Abstr. Int., B).

11480 TEMPERATURE DISTRIBUTION IN M8 AS DETERMINED FROM THE LINE INTENSITY RATIO OF Hα AND NII (λ 6584 A). Hoover, P. S. Ann Arbor, MI; Univ. of Michigan (1972). 103p. University Microfilms Order No. 73-11,151.

Thesis (Ph. D.).

The diffuse nebula, M8, was observed photographically in the emission lines, Hα and NII (λ6584 A). Interference filters of approximately 20 A bandpass were used to isolate these lines. Three plates were obtained in each line with a range of exposure of one to nine. These plates were scanned with a resolution of 5 sec of arc and scans of the three plates in each line were averaged, giving usable relative intensities over most of M8. The ratio Hα/NII was used to explore the electron temperature distribution in M8. The temperature gradient showed a plateau between 3.5 and 6 pc radius where the temperature remains at about 8000°K. A simple model was used to derive a "true" electron temperature gradient from that observed. It is suggested that the rapid increase in observed temperature in the inner 3.5 pc is due to steep density and ionization gradients in this region. Small (spatial) scale fluctuations in the Hα/NII ratio were found on a scale greater than 40 sec of arc, but not below this scale. Fluctuations on this scale are consistent with inhomogeneities in M8 with a scale length of 0.5 to 1 pc. (TSS) (Diss. Abstr. Int., B).

Cosmology

Refer also to abstract 11684.

11481 IMPERFECT FLUID FRIEDMANNIAN COSMOLOGY. Heller, M. (Jagellonian Univ., Krakow); Klimek, Z.; Suszycki, L. Astrophys. Space Sci.; 20: No. 1, 205-212(Jan 1973).

The bulk viscosity is introduced into the frame of ordinary Friedmannian cosmology (under highly idealized assumption of the constant coefficient of bulk viscosity). Explicit solutions are given for the viscous flat Universe filled with the dust-substratum and for the viscous radiative Universe. The problem, how does the introduction of viscosity affect the appearance of singularity, is briefly discussed. (auth)

11482 COMMENTS ON THE PAPER BY MACK AND ROBBINS RELATING TO A RECENT THEORY ON THE ORIGIN OF THE UNIVERSAL X-RAY BACKGROUND. Raychaudhuri, P. (Univ. of Oulu, Finland); Bandyopadhyay, P. Astrophys. Space Sci.; 20: No. 1, 43-46(Jan 1973).

The model for the universal x-ray background featuring thermal emission from supernova remnants proposed by the authors and questioned by Mack and Robbins (1972) is defended. A reply by Mack and Robbins is included. (WDM)

11483 PROBLEM OF ANISOTROPY OF INERTIA. Horak, Z. (Czech Technical Univ., Prague). Bull. Astron. Inst. Czech.; 24: No. 3, 143-149(1973).

It is shown that the original formulation of Mach's principle, essentially equivalent to the general principle of relativity, does not suggest any arguments for the anisotropy of inertia in accordance with the fact that the principle of equivalence implies that an accelerating point mass, embedded in an otherwise homogeneous universe, exerts an additional inertial force, parallel to the acceleration of the point mass, which does not depend on the direction of the line connecting the particle with the point mass, on a test particle at rest. (auth)

11484 GRAVITATIONAL INSTABILITY IN AN ANISOTROPIC UNIVERSE. Johri, V. B. (Gorakhpur Univ., India). Tensor; 25: 241-250(1972).

The Heckmann–Schüking model is chosen as the background model before setting up an orthonormal tetrad system and making tetrad coordinate specializations to suit the dust filled space–time. The field equations and Jacobi identities are written in tetrad form. A cosmological model is then considered which has no symmetries of the background model but the pressure, density, and the equation of state remain the same as in the background model. This so-called "perturbed-model," obtained as a first-order perturbation of the Heckmann–Schüking model, is taken to represent the spatially homogeneous and anisotropic Universe. The gravitational instability is supposed to occur in this model at a certain stage during expansion. The rotational and density perturbations are discussed and the possibility of galaxy formation due to gravitational instability is considered. (WDM)

11485 EQUATIONS FOR A PLASMA CONSISTING OF MATTER AND ANTIMATTER. Nelson, A. H.; Ikuta, K. (Nagoya Univ., Japan). Astrophys. Space Sci.; 20: No. 2, 439-458(Feb 1973).

A set of fluid type equations is derived to describe the macroscopic behavior of a plasma consisting of a mixture of matter and antimatter. The equations are written in a form which displays the full symmetry of the medium with respect to particle charge and mass, a symmetry absent in normal plasmas. This symmetry of the equations facilitates their manipulation and solution, and by way of illustration the equations are used to analyze the propagation of electromagnetic and acoustic waves through a matter–antimatter plasma. Some differences from the propagation of such waves in a normal plasma are noted. (auth)

Planetary Phenomena

Refer also to abstract 10658.

11486 PROCEEDINGS OF THE THIRD LUNAR SCIENCE CONFERENCE. Volume 2. Chemical and Isotope Analyses and Organic Chemistry. Conference held at Houston, Texas, January 10-13, 1972. Heymann, D. (ed.). Geochimica et Cosmochimica Acta, Supplement 3. Cambridge, MA; Massachusetts Institute of Technology (1972). 1080p. (CONF-720121-(Vol. 2)). $32.00.

From 3rd lunar science conference, Houston, Texas, USA (10 Jan 1972).

Separate abstracts were prepared for sixty of the papers presented. (WDM)

For abstracts of individual papers see: 10658, and 11487–11545.

11487 DISTRIBUTION OF ELEMENTS BETWEEN DIFFERENT PHASES OF APOLLO 14 ROCKS AND SOILS. Brunfelt, A. O. (Mineralogical-Geological Museum, Oslo); Heier, K. S.; Nilssen, B.; Sundvoll, B.; Steinnes, E. Geochim. Cosmochim. Acta; Suppl. 3: 1133-1147(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121–(Vol. 2).

Neutron activation analysis data are given for samples 14163 (soil), 14276 (breccia), 14303 (breccia), and 14310 (crystalline rock). Two polished thin sections of breccia 14303 were studied and electron-microprobe data are given on the constituent minerals. Orthopyroxene separate from rock 14310 was also analyzed by electron microprobe. Data are given on plagioclase, orthopyroxene, three glass fractions, and two rock fractions from sample 14163, and on plagioclase and orthopyroxene fractions from rock 14310. The different glass and rock fractions of sample 14163 have similar compositions. Published modal analyses of 14310 show that plagioclase plus pyroxene constitute about 95% of the rock. Most of the trace elements are concentrated in the remaining 5%. Iron is also concentrated in this fraction being probably related to the presence of metallic iron in the sample. (auth)

11488 OXYGEN AND BULK ELEMENT COMPOSITION STUDIES OF APOLLO 14 AND OTHER LUNAR ROCKS AND SOILS. Ehmann, W. D. (Univ. of Kentucky, Lexington); Gillum, D. E.; Morgan, J. W. Geochim. Cosmochim. Acta; Suppl. 3: 1149-1160 (1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121–(Vol. 2).

Abundances of O, Si, Al, Mg, and Fe were determined in 13 rock samples and 3 soils from the Apollo 14 mission. Most of the crystalline rocks and breccias fall closely along a Si-rich extension of the Si–O regression line reported for Apollo 11 crystalline rocks: O% = 0.98 Si% + 20.8 (Ehmann and Morgan, 1970). This slope is significantly different than that for terrestrial igneous rocks, and the lunar rocks are depleted by 1 to 2% O with respect to terrestrial rocks of comparable Si contents. The lunar fines exhibit an excess O deficiency in addition to that determined by the mineralogy. Various models for this depletion are discussed in the light of recent data. The bulk chemistry of rock 14053 is similar to that found for a clast in breccia 14321 and also resembles that for Si-rich basalt 12064. Rock 14310 has the highest Al abundance and Al/Si ratio of any bulk lunar material analyzed and may represent remelted soil from near the mountain fronts. Additional data are presented for abundances in Apollo 11 and Lunar 16 sieved fines and Apollo 12 rocks and fines. (auth)

11489 BULK, RARE EARTH, AND OTHER TRACE ELEMENTS IN APOLLO 14 AND 15 AND LUNA 16 SAMPLES. Laul, J. C.; Wakita, H.; Schowalter, D. L.; Boynton, W. V.; Schmitt, R. A. (Oregon State Univ., Corvallis). Geochim. Cosmochim. Acta; Suppl. 3: 1181-1200(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121–(Vol. 2).

The chemical abundances of 24 and 34 bulk, minor, and trace elements were measured by instrumental and radiochemical neutron activation analysis, respectively, in a variety of lunar specimens. (WDM)

11490 COMPOSITIONAL CHARACTERISTICS OF SOME APOLLO 14 CLASTIC MATERIALS. Lindstrom, M. M.; Duncan, A. R.; Fruchter, J. S.; McKay, S. M.; Stoeser, J. W.; Goles, G. G.; Lindstrom, D. J. (Univ. of Oregon, Eugene). Geochim. Cosmochim. Acta; Suppl. 3: 1201-1214(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121–(Vol. 2).

Eighty-two subsamples of Apollo 14 materials were analyzed by instrumental neutron activation analysis techniques for as many as 25 elements. In many cases, it was necessary to develop new procedures to allow analyses of small specimens. Compositional relationships among Apollo 14 materials indicate that there are small but systematic differences between regolith from the valley terrain and that from Cone Crater ejecta. Fragments from 1 to 2 mm size fractions of regolith samples may be divided into compositional classes, and the "soil breccias" among them are very similar to valley soils. Multicomponent linear mixing models were used as interpretive tools in dealing with data on regolith fractions and subsamples from breccia 14321. These mixing models show systematic compositional variations with inferred age for Apollo 14 clastic materials. (auth)

11491 COMPOSITION OF THE LUNAR UPLANDS: CHEMISTRY OF APOLLO 14 SAMPLES FOR FRA MAURO. Taylor, S. R.; Kaye, M.; Muir, P.; Nance, W.; Rudowski, R.; Ware, N. (Australian National Univ., Canberra). Geochim. Cosmochim. Acta; Suppl. 3: 1231-1249(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

Data are presented for 45 elements in two lunar soils (14003, 14163); two crystalline rocks (14072, 14310); a breccia (14047); basalt and troctolite clasts from 14321; matrix, light and dark fragments from 14306; and matrix from 14063. The most striking feature is the high concentration of alkali elements, REE, Th, U, Zr, Hf, and so forth. The samples from the smooth terrain unit of the Fra Mauro formation form a uniform compositional group. This, coupled with the diversity in composition of the fragments and clasts, suggests a thorough mixing process, identified with pre-Imbrium cratering, and the Imbrium event. The Fra Mauro chemistry differs from primitive solar nebula abundances, being strongly enriched in involatile elements, and depleted in volatiles. It is high in Ni due to addition of a meteoritic component. The enrichment of the nonvolatile elements over chondritic abundances is shown to depend in detail on crystal chemical factors of ionic radius and valency. This is interpreted as indicating extensive melting of the outer regions of the Moon, with cooling and solidification occurring before the final stages of upland cratering and the Imbrium event. (auth)

11492 MULTIELEMENT ANALYSES OF LUNAR SAMPLES AND SOME IMPLICATIONS OF THE RESULTS. Waenke, H.; Baddenhausen, H.; Balacescu, A.; Teschke, F.; Spettel, B.; Dreibus, G.; Palme, H.; Quijano-Rico, M.; Kruse, H.; Wltozka, F.; Begemann, F. (Max-Planck-Institut fuer Chemie, Mainz). Geochim. Cosmochim. Acta; Suppl. 3: 1251-1268(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

The concentrations of 48 major, minor, and trace elements were determined in 10 lunar samples from Apollo 14 and 15 and in the achondrites, Juvinas, and Kapoeta. Among these elements F was studied more extensively to clarify some discrepancies in the literature about this element. A three-component mixing model for the lunar soils and breccias was set up. In this way large amounts of KREEP and of anorthosite were proved to be present in all Apollo 15 soils and breccias. The anorthosite content is highest for samples from the mountain front and decreases with increasing distance from the front. It is shown that besides U, Th, and Hf also Ta and W are related with KREEP. KREEP seems to have been added to all mare basalts; noticeable especially for the elements K and La. La, U, Th, and many other trace elements are found to be enriched in the Apollo 14 samples up to a factor 400 as compared to chondritic values. The nearly identical composition of Apollo 12 KREEP and the Apollo 14 soils and breccias and their distribution as Imbrium ejecta is taken as evidence that the layer of KREEP rocks (norite layer see Wood et al., 1971) must be at least a factor of 10 thicker than the upper limit of 1.5 km that one would get for a layer enriched 400 times in certain elements. The conclusion of Gast and McConnell (1972) about an initial chemical layering of the Moon is therefore strongly supported. Specifically the upper 200 km is suggested to have had initially an about eucritic or two times eucritic abundance of the elements in question including K. With this assumption the thermal history of the moon could also be brought in accord with the observations. Furthermore, it is shown that with such a composition even small planetesimals would melt within a few hundred million years after accretion. A number of elements that are of meteoritic origin were studied also and attempts were made to distinguish between Imbrian and post-Imbrian components. (auth)

11493 RARE EARTHS AND OTHER TRACE ELEMENTS IN APOLLO 14 SAMPLES. Helmke, P. A.; Haskin, L. A.; Korotev, R. L.; Ziege, K. E. (Univ. of Wisconsin, Madison). Geochim. Cosmochim. Acta; Suppl. 3: 1275-1292(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

REE and other trace elements have been determined in igneous rocks 14053, 14072, and 14310, in breccias 14063 and 14313, and in fines 14163. All materials analyzed have typical depletions of Eu except for feldspar fragments from the breccias and igneous fragments from 14063. Igneous rocks 14072 and 14053 have REE concentrations very similar to Apollo 12 basalts; 14310 has the highest REE concentrations yet observed for a large fragment of lunar basalt. The effects of crystallization of a basaltic liquid as a closed system on the concentrations of Sm and Eu in feldspar are considered. Small anorthositic fragments may have originated by simple crystallization from very highly differentiated basalt (KREEP) or by closed-system crystallization in a less differentiated starting material. Application of independent models of igneous differentiation to Sm and Eu in massive anorthosite 15415 and to Sm and Eu in lunar basalts suggests a common starting material with a ratio of concentrations of Sm and Eu about the same as that in chondrites and with concentrations of those elements about 15 times enriched over chondrites. (auth)

11494 PRECISE DETERMINATION OF RARE-EARTH ELEMENTS IN THE APOLLO 14 AND 15 SAMPLES. Masuda, A. (Tokyo Univ.); Nakamura, N.; Kurasawa, H.; Tanaka, T. Geochim. Cosmochim. Acta; Suppl. 3: 1307-1313(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

Rare earth (REE) abundances not only in lunar samples but also in chondrites were determined precisely. It was found that there is a positive cerium anomaly when normalized against the REE abundances in a representative L chondrite (Leedey) and that the extent of the anomaly is variable from site to site. In contrast with lanthanum in terrestrial rocks, the behavior of La in lunar materials is regular in association with Nd and Sm. This is in accord with the lunar magmas being dry. The chondrite-normalized REE patterns of lunar samples studied have a small gap between Sm and Gd, apart from an Eu negative anomaly. It is inferred that Fra Mauro materials and Apennine front soils are the most representative highland materials and are originally the quenched liquids which were left after nearly total melting and subsequent extensive differential solidification. (auth)

11495 PROVENANCE OF APOLLO 12 KREEP. Wasson, J. T.; Baedecker, P. A. (Univ. of California, Los Angeles). Geochim. Cosmochim. Acta; Suppl. 3: 1315-1326(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

Four possible origins for Apollo 12 KREEP can be distinguished: (1) ejecta from Copernicus; (2) ejecta from Reinhold; (3) ejecta from the local highlands; and (4) material excavated from Fra Mauro deposits buried below the landing site. The first three sources do not appear able to account for the substantial deposits of KREEP found near the crests of Head and Bench Craters. This material appears to be buried Fra Mauro material brought to a near surface location (as demanded by the high neutron dosage) as ejecta from Middle Crescent Crater. KREEP in the common soil (e.g., 12070) at the Apollo 12 site appears to be a mixture of roughly equal proportions of Fra Mauro materials from each of the four proposed sources. Insofar as the U-Pb metamorphism ages of Apollo 12 soils date real events, the most likely candidates are (1) the formation of Middle Crescent Crater for the 12032 and 12033 soils, and (2) the formation of Copernicus and Reinhold for the 12070 soils. (auth)

11496 EXTRALUNAR COMPONENT IN LUNAR SOILS AND BRECCIAS. Baedecker, P. A.; Chou, C. L.; Wasson, J. T. (Univ. of California, Los Angeles). Geochim. Cosmochim. Acta; Suppl. 3: 1343-1359(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

Concentrations of Ni, Zn, Ga, Ge, Cd, In, and Ir in soils and breccias returned by Apollo 14 and Apollo 15 are reported. The integrated flux of extralunar material at each lunar landing site is estimated on the basis of the siderophilic elements Ni, Ge, Ir, and Au. It falls with time between 3.95 and 3.26 g.y. before the present. The flux versus time relationship indicated by the trace element data is consistent with estimates of the same relationship based on crater statistics and morphologies, as would be expected if the same populations of interplanetary objects were responsible for both properties. The data are consistent with the presence of two populations of material bombarding the moon early in its history, one with a short half-life that was dominant until about 3.8 g.y. ago, and another with a half-life of about 2.0 g.y. that dominated during the more recent era. (auth)

11497 TRACE ELEMENTS IN APOLLO 15 SAMPLES: IMPLICATIONS FOR METEORITE INFLUX AND VOLATILE DEPLETION ON THE MOON. Morgan, J. W.; Kraehenbuhl, U.; Ganapathy, R.; Anders, E. (Univ. of Chicago). Geochim. Cosmochim. Acta; Suppl. 3: 1361-1376(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

Five Apollo 15 soils and four rocks were analyzed by neutron activation analysis for Ag, Au, Bi, Br, Cd, Co, Cs, Ge, In, Ir, Ni, Sb, Se, Rb, Re, Te, Tl, and Zn. Elbow Crater soil 15081, collected 65 m from the rim, contains a meteoritic component equivalent to 1.72% Cl material, similar to that at other lunar sites. Other soils are lower, owing to dilution by fresh bedrock or talus from the Apennine Front. A component rich in Rb, Cs, Cd, and Zn (KREEP?) seems to be present in all soils, but though the abundance of these elements is highest in soil 15431 from the front, it does not decrease regularly with distance from the front. Hence the front may not be the only or even the principal source of KREEP. Anorthosite 15415 is outstandingly low in these elements. Apollo 11 anorthosites, on the other hand, contain a sizable meteoritic component, similar to that in Apollo 14 dark norites. This component may represent debris of the Imbrian or Serenitatis projectiles or mixed planetesimal debris from the pre-Imbrium

regolith. Apennine Front basalt 15256 is high in Tl, In, Br, Sb, and especially Cd, but otherwise it resembles Apollo 15 mare basalts, which in turn are similar to Apollo 11, 12 mare basalts. Apollo 14 norites and basalts are enriched in most elements that we measured. Apollo 14 rocks may have a slightly higher Tl/Cs ratio [$(1.6 \pm 1.2) \times 10^{-2}$ versus $(1.0 \pm 0.9) \times 10^{-2}$] than Apollo 11, 12, 15 basalts, anorthosites, "granites" (12013), or Luna 16 soil. The mean Tl/Cs ratio of all Apollo rocks, $(1.2 \pm 1.0) \times 10^{-2}$, still is more than an order of magnitude below the terrestrial and eucritic ratios. The mean Cs/U ratio is 0.23 ± 0.11, 1.5% the cosmic ratio. In terms of the two-component model of planetary accretion, this suggests that the moon contains only ~1.5% low-temperature material, with a nominal accretion temperature of ~450°K. Comparison with the earth and 6 meteorite classes shows that the moon's depletion is unique. Possibly this reflects accretion in the earth's neighborhood. (auth)

11498 MAJOR IMPACTS ON THE MOON: CHARACTERIZATION FROM TRACE ELEMENTS IN APOLLO 12 AND 14 SAMPLES. Morgan, J. W.; Laul, J. C.; Kraehenbuhl, U.; Ganapathy, R.; Anders, E. (Univ. of Chicago). Geochim. Cosmochim. Acta; Suppl. 3: 1377-1395(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

Seventeen trace elements (Ag, Au, Bi, Br, Cd, Co, Cs, Ge, In, Ir, Rb, Re, Sb, Se, Te, Tl, and Zn) were determined by neutron activation analysis in 33 lunar samples from Apollo 14, 5 from Apollo 12, and 2 from Luna 16. Apollo 14 soils and breccias contain at least two, and possibly three, ancient meteoritic components of unusual composition, probably derived from the Imbrian and Serenitatis impacts, and mixed planetesimal debris from the pre-Imbrian regolith. These components have a lower ratio of volatiles (Ag, Ge, Sb, Se) to siderophiles (Ir, Re, Au, Ni) than any known class of chondrites. They also have Ir/Au, Ge/Au ratios outside the range for most iron meteorites, except Groups IVA and possibly IIIA. One of these components, of very low Ir/Au, Re/Au ratio, occurs in light norites, 14321 microbreccias, and KREEP separates from 12033 soil. Another is found in dark norites, glasses, and several other Apollo 14 samples, as well as rock 12013 and Apollo 11 anorthosite. From these compositional clues it appears that the Imbrian body and the pre-Imbrian planetesimals, like the earth, were relatively rich in iron (≥20% Fe), but depleted in volatiles (<10% of cosmic abundance). Such a composition is consistent with the Imbrian body originating as an earth-crossing planetesimal. Other arguments (impact velocity, age of Imbrian basin), support this view. An asteroidal origin may be less likely, but still possible. (auth)

11499 ABUNDANCES OF COMPONENTS OF THE LUNAR SOILS BY A LEAST-SQUARE MIXING MODEL AND THE FORMATION AGE OF KREEP. Schonfeld, E.; Meyer, C. Jr. (Manned Spacecraft Center, Houston, TX). Geochim. Cosmochim. Acta; Suppl. 3: 1397-1420(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

The chemical composition of lunar soils and breccias has been closely matched by a least-squares mixing model that includes mare basalts, KREEP basalts, anorthosites, anorthositic gabbros, ultramafics, granites, and meteorites as component materials. Each of these end member components has been directly observed in the coarse fraction of the soil samples and has previously been considered as fundamental rock types on the basis of their distinctive chemical compositions and mineral associations. The chemical compositions for the soils, breccias, and each of the components used in this mixing model include data for about 30 elements (Si, Ti, Al, Ca, Fe, Mg, P, Cr, Mn, Na, K, Rb, Ba, U, Th, La, Ce, Sm, Eu, Sr, Yb, Y, Sc, V, Zr, Nb, Co, Ni, Li, Au, Ir). The results of the chemical mixing model show that iron-rich mare basalt (<15% Al_2O_3) is the dominant material (35-80%) at the Apollo 11, 12, 15, Luna 16, and Surveyor 5 and 6 sites. KREEP basalt (15-22% Al_2O_3) is found to be present at all sites, but is most abundant at the Apollo 12, 14, 15, and possibly Surveyor 7 sites. Anorthositic material (>22% Al_2O_3) is found to be an important component (~20%) of the Apollo 11, Luna 16, some Apollo 15 and Surveyor 7 soils. Meteoritic, granitic, and ultramafic components are only present in small amounts (<5%). Basalt 14310 can be considered to be a mixture of ~8% mare basalt, ~65% KREEP basalt, ~25% anorthosite, and ~3% meteorite; and should, therefore, be considered a melted soil. Basalt 14053 can be considered to be a mare basalt contaminated at depth with ~7% KREEP basalt. The component percentages of KREEP basalt and granite are found to be correlated, suggesting a common source for these two rock types. Breccias and core tube samples have variable component abundances indicating that the lunar regolith is not well mixed at any site. The KREEP basalt component is the most important contributor of K, U, Th, Rb, REE, and radiogenic Sr in the soils (about 30% in the Apollo 11 soil, about 90% in the Apollo 12 soils, about 95-99% in the Apollo 14 soils, and about 80-90% in the Apollo 15 soils). In the Apollo 11 and 12 soils, there is no evidence of Rb or $^{87}Sr^*$ transfer; whereas the excess radiogenic lead in the Apollo 11 and 14 soils and the depletion of such lead in the Apollo 12 soils suggest volatile transfer of lead. A two-stage Rb-Sr evolution model gives a formation age for the KREEP basalt of 4.41± 0.06 billion years. (auth)

11500 $^{18}O/^{16}O$, $^{30}Si/^{28}Si$, $^{13}C/^{12}C$, AND D/H STUDIES OF APOLLO 14 AND 15 SAMPLES. Epstein, S.; Taylor, H. P. Jr. (California Inst. of Tech., Pasadena). Geochim. Cosmochim. Acta; Suppl. 3: 1429-1454(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

New $\delta^{18}O$ and $\delta^{30}Si$ data on Apollo 14 and 15 samples further confirm the remarkable isotopic similarity of lunar rocks from different sites. As in the case of Apollo 11 and 12 samples, the lunar fines are enriched in ^{18}O and ^{30}Si relative to the crystalline rocks from which they are derived. Certain Apollo 14 breccias (F-2) are also enriched in ^{18}O, and thus may in large part be derived from lunar soil. The Apollo 14 bottom trench samples are depleted in ^{18}O relative to surface soils. The anorthosite 15415 has a $\delta^{18}O$ very similar to that obtained for plagioclases in the lunar basalts. Utilizing successive partial fluorinations, large ^{18}O and ^{30}Si enrichments (up to +55 and +30‰, respectively) were observed on the surfaces of grains of all Apollo 14 and 15 fines, but no such enrichment exists for 14321, a rock breccia (class F-4). These large ^{18}O- and ^{30}Si-enrichments are directly related to the amount of solar wind hydrogen present in the sample. These isotopic effects must be a result of exposure of the lunar fines to bombardment by meteorites, micrometeorites, and/or nuclear particles, with preferential loss of ^{28}Si and ^{16}O by fractional vaporization, or preferential gain of ^{30}Si and ^{18}O by fractional condensation. These effects are accompanied by a reduction in the overall oxygen/silicon ratio, indicating that the O_2/Si ratio of material carried away during vaporization is >2. Further confirmation has been obtained that the deuterium concentration in hydrogen gas extracted from the lunar fines is less than about 3 ppM. Even this small amount of deuterium could be due to spallation because an abnormally deuterium-rich fraction of gas was extracted during the melting of the lunar samples. The bulk of the hydrogen in the lunar fines is clearly of solar wind origin; the latter apparently has a δD value close to −1000 (0 ppM deuterium). The small amounts of H_2O (~10 μmole/g) extracted from one lunar soil and one rock breccia have $\delta^{18}O$ values of −5.9 and −18.2, well within the $\delta^{18}O$ range of terrestrial atmospheric H_2O. Taken together with other considerations, this strongly indicates that most of this water is a terrestrial contaminant taken to the moon by the Apollo spacecraft or added to the samples after their return to earth. The carbon concentrations and the $\delta^{13}C$ values in lunar samples are both highly variable, about 10 to 260 ppM and about −30 to +20, respectively. Nonetheless, there is a progressive enrichment in $\delta^{13}C$ with increasing carbon content, and all the data can be explained by mixing solar wind carbon having a variable $\delta^{13}C$ of +10 to +25 with lunar basalts containing about 25 ppM carbon and having a $\delta^{13}C = -30$ to −20. However, because of possible addition of meteoritic carbon, and because of possible ^{13}C enrichment due to particle bombardment, at this time it cannot definitely be determined whether the bulk of the lunar carbon is of solar wind or meteoritic origin. (auth)

11501 OXYGEN ISOTOPIC COMPOSITIONS AND OXYGEN CONCENTRATIONS OF APOLLO 14 AND 15 ROCKS AND SOILS. Clayton, R. N.; Hurd, J. M.; Mayeda, T. K. (Univ. of Chicago). Geochim. Cosmochim. Acta; Suppl. 3: 1455-1463(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

Some Apollo 14 igneous rocks, and basaltic clasts from fragmental rocks, have intermineral oxygen isotopic fractionations larger than typical igneous values, resulting from some post-crystallization thermal event. Apollo 15 basalt 15016 has normal igneous fractionation factors. The $\delta^{18}O$ of microbreccia clasts from Apollo 14 fragmental rocks is correlated with the textural classification of the rock, showing ^{18}O enrichment for class F2, and none for class F4. Accurate determination of departures of oxygen content from normal stoichiometric values may aid in understanding the nature and origin of the ^{18}O and ^{30}Si rich component in lunar soils. (auth)

11502 ISOTOPIC ABUNDANCE RATIOS AND CONCENTRATIONS OF SELECTED ELEMENTS IN APOLLO 14 SAMPLES. Barnes, I. L.; Carpenter, B. S.; Garner, E. L.; Gramlich, J. W.; Kuehner, E. C.; Machlan, L. A.; Maienthal, E. J.; Moody, J. R.; Moore, L. J.; Murphy, T. J.; Paulsen, P. J.; Sappenfield, K. M.; Shields, W. R. (National Bureau of Standards, Washington, DC). Geochim. Cosmochim. Acta; Suppl. 3: 1465-1472(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

Absolute or relative isotopic abundance ratios were determined for U, Pb, Rb, Sr, Ca, and Cu on a representative fraction of the bulk fines 14163,159 and for a breccia 14321,221. No significant variations from terrestrial values were noted for the nonradiogenic isotopes. Concentrations were determined for the above elements as well as for Th, B, Ag, Cd, Fe, Tl, and Ni. $^{207}Pb/^{206}Pb$ ages of about 4860 m.y. (million years) and 4420 m.y. were calculated for 14163 and 14321, respectively. The Pb-U and Pb-Th ages are very slightly discordant, the soils exhibit a reversed discordancy and the breccia a normal discordancy. Extreme inhomogeneity of Rb and Sr in the fines sample was found. (auth)

11503 DEUTERIUM CONTENT OF LUNAR MATERIAL. Merlivat, L.; Nief, G.; Roth, E. (CEN de Saclay, Gif-sur-Yvette, France). Geochim. Cosmochim. Acta; Suppl. 3: 1473-1477(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

The hydrogen and deuterium content of lunar samples 10019, 14003, and 14259 were measured. Water extracted from the samples 10019 and 14259 was also analyzed. Equivalent amounts of H_2 and H_2O equal to about 20 μmole/g were found. The measured concentration of deuterium was 20 ppM in hydrogen and 100 ppM in water. The conditions of isotopic exchange between hydrogen and water vapor were investigated and are reported. Consideration of the influence of these exchange processes led to an assignment of an upper limit of 13 ppM to the D content of hydrogen. In addition, constraints were placed on the origin of the water. The fact that no hydrogen was released from the fines or breccias at temperatures above 650°C was explained by experiments showing that oxidation starts at 575°C. (auth)

11504 SULPHUR CONCENTRATIONS AND ISOTOPE RATIOS IN LUNAR SAMPLES. Rees, G. E.; Thode, H. G. (McMaster Univ., Hamilton, Ont.). Geochim. Cosmochim. Acta; Suppl. 3: 1479-1485(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

Sulphur concentrations for the Apollo 12 and 14 samples analyzed lie in the range 549 ppM to 1149 ppM. Fines, and to a lesser extent breccias, are enriched in heavy sulphur isotopes relative to the rocks. The abundance patterns for ^{33}S, ^{34}S, and ^{36}S relative to ^{32}S for Apollo 11, 12, and 14 samples are consistent with derivation from a primitive sulphur source via mass dependent isotope fractionation. There is inhomogeneity of both sulphur concentration and sulphur isotope abundances within individual samples and there are indications that in an Apollo 14 fines sample the individual troilite grains may be isotopically inhomogeneous. (auth)

11505 APOLLO 14 MINERAL AGES AND THE THERMAL HISTORY OF THE FRA MAURO FORMATION. Compston, W.; Vernon, M. J.; Berry, H.; Rudowski, R.; Gray, C. M.; Ware, N.; Chappell, B. W.; Kaye, M. (Australian National Univ., Canberra). Geochim. Cosmochim. Acta; Suppl. 3: 1487-1501(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

Rb-Sr mineral isochrons for two basalt clasts from the partially annealed breccia 14321 (4.06 b.y.) are detectably older than 14310 (3.93 b.y.). Less precise ages for a troctolite clast from 14321 and the igneous chip 14072 can agree with either of these. A directionally consistent thermoremanent magnetism in 14321 reported by Pearce et al. shows that the temperature of this breccia was at least 800°C after final assembly. If the annealing of the breccia occurred within the Fra Mauro formation after deposition, temperatures may have remained above 600°C for as long as $\sim 10^2$ yr owing to thermal blanketing. During such a thermal event, the estimated diffusion ranges of Rb and Sr in glass (mesostasis), plagioclase, and possibly pyroxene would exceed the basalt grainsize and probably produce local equilibration of Sr isotopes between minerals. The age of the 14321 clasts would therefore represent the age of the Imbrium impact on this model, and 14310 would be a post-Fra Mauro rock rather than a Fra Mauro breccia clast. On the other hand, if the Fra Mauro formation was deposited at low temperatures, the ages of the clasts and their magnetization would represent pre-Imbrian events, and only a limiting age of younger than 3.9 b.y. can be set for the Imbrium impact. (auth)

11506 APOLLO 14 AND 15 SAMPLES: Rb-Sr AGES, TRACE ELEMENTS, AND LUNAR EVOLUTION. Rama Murty, V.; Evensen, N. M.; Jahn, B.; Coscio, M. R. Jr. (Univ. of Minnesota, Minneapolis). Geochim. Cosmochim. Acta; Suppl. 3: 1503-1514 (1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

The Apollo 14 basalt sample 14310 was dated by the Rb-Sr internal isochron method at 3.93 ± 0.06 AE (1 Aeon = AE = 10^9 years), making it the oldest lunar basalt measured to date. The unusually high initial $^{87}Sr/^{86}Sr$ ratio (0.70033 ± 19) and K, Rb, Ba abundances in this rock are probably due to contamination of primitive basaltic material by a trace-element rich layer near the lunar surface. Further interpretation depends upon the question of whether the formation of 14310 basalt pre- or post-dates the Mare Imbrium excavation. Chemical and isotopic characteristics of the Apollo 14 soils permit their derivation by comminution of local rocks, in contrast to the situation for Apollo 12 and 15 soils. To date, all lunar soils show variable fractions of an "exotic component" that must be an early differentiated material on the moon, rich in trace elements and radiogenic Sr. From the size fraction analyses of some Apollo 14 and 15 soil samples and the inferences made on the abundances of the exotic component in Apollo 11, 12, and Luna 16 soils, it is suggested that this ubiquitous component is the Fra Mauro material itself or the trace-element rich layer from which it is derived, excavated by the Imbrian impact event from considerable depths in the moon, and distributed widely both at the time of the Imbrian event and at later times by impacts such as the Copernican event. The Apollo 15 basalt 15555 was dated by the Rb-Sr internal isochron method at 3.30 ± 0.08 AE, in complete agreement with a K-Ar date on the plagioclase separate. Both in age and trace element contents this basalt is very similar to mare basalts from the Ocean of Storms. Thus, it appears that extensive volcanism and mare flooding occurred on the lunar surface at ~3.3 AE ago, suggesting that mare basalt generation is due to the internal thermal regime of the moon. Total samples and size fractions of soils from the Apollo 14 site (14149, 14259) and the Apollo 15 site (15531) uniformly show model ages close to 4.6 AE despite almost an order of magnitude variation in their Rb-Sr ratios. Apollo 11 and 12 soils show similar characteristics. The Rb-Sr systematics of the soils point to a primordial differentiation of the moon at 4.6 AE ago. This is inferred directly from the nature of the exotic component and indirectly from the mare basalt material, whose Rb-Sr behavior may have been controlled by partial melting of early formed Rb-rich phases in the interior of the moon. (auth)

11507 Rb-Sr SYSTEMATICS FOR CHEMICALLY DEFINED APOLLO 14 BRECCIAS. Nyquist, L. E. (Manned Spacecraft Center, Houston, TX); Hubbard, N. J.; Gast, P. W.; Church, S. E.; Bansal, B. M.; Wiesmann, H. Geochim. Cosmochim. Acta; Suppl. 3: 1515-1530(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

Chemical analyses and whole rock Rb-Sr systematics of selected Apollo 14 breccias and breccia fragments from soil 14161 show that at least breccias of high metamorphic grade underwent thermal metamorphism 3.94 ± 0.12 AE ago (1 Aeon = AE = 10^9 years). As the Imbrium impact is a known source of energy the 3.9 AE age is identified with this event. It is suggested that the Rb-Sr systematics of these breccias are dominated by granophyre patches rich in K, Rb, and Ba, prompting a comparison of chronologies for KREEP breccias and rock 12013. A two-stage model comparison of KREEP breccias and 12013 "granites" using initial $^{87}Sr/^{86}Sr$ ratios yields total model ages of 4.40 AE and 4.47 AE, respectively. This age difference vanishes if equal metamorphic ages of 3.95 AE are assumed. In this case coincident two-stage model ages of 4.42 AE result. A whole rock age of 4.0 ± 0.2 AE and model age of 4.43 AE is obtained from 24 KREEP materials analyzed to date. The possibility that the chronologies of KREEP and "granites" are related merits serious consideration. (auth)

11508 U-Th-Pb AND Rb-Sr MEASUREMENTS ON SOME APOLLO 14 LUNAR SAMPLES. Tatsumoto, M.; Hedge, C. E.; Doe, B. R.; Unruh, D. M. (Geological Survey, Denver). Geochim. Cosmochim. Acta; Suppl. 3: 1531-1555(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

The U-Th-Pb and Rb-Sr systems were studied on selected samples collected by the Apollo 14 mission. Concordia diagram treatment of U-Pb and U-Th-Pb of whole samples of breccias and rocks, and those of density fractions of a rock (basalt 14310) revealed that the 4650-m.y.-old source material was subjected to an event at about 3800 m.y. ago. This event resulted in formation of two igneous rocks (probably from melting of regolith) and numerous breccias. Support for the 4650-m.y. age of the source material was also obtained by use of the Rb-Sr method on whole-soil samples. An internal isochron was obtained for density fractions from the igneous rock 14310 on $^{206}Pb/^{207}Pb$ versus $^{238}U/^{207}Pb$ and $^{208}Pb/^{207}Pb$ versus $^{232}Th/^{207}Pb$ plots. The resultant isochron from the former method is 3800 ± 300 m.y. and agrees well with the Rb-Sr mineral isochron age of 3840 m.y. The most significant feature of Apollo 14 samples is that most whole-soil and whole-breccia samples (and basalt 14053) give evidence of significant in-

crease of lead relative to uranium and thorium billions of years ago at the Fra Mauro site. This increase contrasts with evidence from Apollo 11 and Apollo 12 samples of lead loss or no change in lead content relative to those of uranium and thorium since the moon formed. Lead enrichment probably took place owing to two or more events. After lunar formation at about 4650 m.y., the second event is probably related to the time of basalt formation, interpreted to have occurred 3800 m.y. ago. In this event, the value of $^{238}U/^{204}Pb$ in basalt 14310 and breccia 14063 increased and decreased in basalt 14053, breccias 14307 and 14318, and soils 14003, 14163, and 14259 relative to their source materials. A "third event" may have occurred in the interval from 2000-3000 m.y. ago. There is no evidence that the basalts were affected by this event, nor is there clear evidence of any effect on 14163 soil, but soils 14259 and 14003 increased in $^{238}U/^{204}Pb$. (auth)

11509 AGES OF LUNAR MATERIAL FROM FRA MAURO, HADLEY RILLE, AND SPUR CRATER. Husain, L.; Schaeffer, O. A.; Funkhouser, J.; Sutter, J. (State Univ. of New York, Stony Brook). Geochim. Cosmochim. Acta; Suppl. 3: 1557-1567(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

Twelve crystalline and fragmental rocks from Fra Mauro and six rocks from Hadley Rille and Spur Crater were dated by the $^{40}Ar-^{39}Ar$ technique. Three characteristic types of thermal release patterns are observed that may influence the derived $^{40}Ar-^{39}Ar$ age by up to 0.1×10^9 yr. High-temperature ages from Fra Mauro suggest that the Imbrium Basin was excavated $(3.7 - 3.9) \times 10^9$ yr ago. An age of a Fra Mauro clastic fragment of 3.50×10^9 yr may represent the time of another major impact event. The crystallization age of the basalts from Hadley Rille and Spur Crater all group at $3.25 \pm 0.1 \times 10^9$ yr indicating that at least a portion of Mare Imbrium filled with basalt about 500×10^6 yr after its formation. Cosmic-ray exposure ages were determined from $^{38}Ar_{sp}/^{37}Ar$ versus ^{37}Ar thermal release patterns. Such ages compare favorably with those calculated in the standard manner from unirradiated sample chips. A grouping at about 30×10^6 yr probably defines the Cone Crater event. The ages of the remaining samples from both landing sites vary widely, from 80 to 740×10^6 yr, with no apparent age groupings. (auth)

11510 K-Ar DATING OF LUNAR FINES: APOLLO 12, APOLLO 14, AND LUNA 16. Pepin, R. O.; Bradley, J. G.; Dragon, J. C.; Nyquist, L. E. (Univ. of Minnesota, Minneapolis). Geochim. Cosmochim. Acta; Suppl. 3: 1569-1588(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 2).

K-Ar ages of <1 mm fines from the Apollo 12, Apollo 14, and Luna 16 sites range between 0.95 and 4.20×10^9 yr (AE). The 0.95 AE age of the Apollo 12 KREEP soil component is slightly higher than but in reasonable agreement with the age of 0.85 AE deduced by other workers from the U/Pb and $^{40}Ar/^{39}Ar$ techniques. It appears that two chronologically distinct low-K components, of ages ~2.8 AE and ~4.0 AE, must be present in the Apollo 12 soils to accommodate the age data. One of these, at ~2.8 AE, could relate to local rock ages through diffusive Ar loss. Dating of grain-size separates of two Apollo 14 soils yields ages between 2.4 AE and 2.95 AE for one, and 4.20 AE for the other; in the latter sample, the trench-bottom fines, there is evidence for an unusual concentration of parentless ^{40}Ar in the <37 μ size fractions. Ages of <125 μ fine fines from both the ~6.5 cm layer and the ~30 cm layer of the Luna 16 core are less precise, but do appear to differ significantly; the values are ≈2.7 AE for the upper level and ~4.0 AE for the lower. Ordinate intercept correlations for the Apollo 14 and Luna 16 samples give an average value for $^{38}Ar/^{36}Ar$ in the solar wind of 0.1849 ± 0.0008. There appears to be a difference of ~7‰ in this ratio between the upper and lower Luna 16 core samples. Cosmic ray exposure ages are close to 440 m.y. for both Apollo 14 samples and close to 840 m.y. for both Luna 16 samples. When the K-Ar soil ages reported here are combined with approximate Apollo 11 soil ages deduced from literature data, and considered as a group, it is clear that they tend to fall in ~500 m.y. epochs centered around ~2.8 AE and ~4.0 AE, for all four lunar sites. Only the Apollo 12 KREEP component, probably dispersed by the Copernican impact, is clearly younger. (auth)

11511 $^{40}Ar-^{39}Ar$ SYSTEMATICS IN ROCKS AND SEPARATED MINERALS FROM APOLLO 14. Turner, G.; Huneke, J. C.; Podosek, F. A.; Wasserburg, G. J. (California Inst. of Tech., Pasadena). Geochim. Cosmochim. Acta; Suppl. 3: 1589-1612(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

The $^{40}Ar-^{39}Ar$ dating technique was applied to separated minerals (plagioclase, pyroxene, quintessence and an "ilmenite" concentrate), and whole rock samples of Apollo 14 rocks 14310 and 14073. Plagioclase shows the best gas retention characteristics, with no evidence of anomalous behavior and only a small amount of gas loss in the initial release. Ages determined from the plagioclase of 14310 and 14073 are (3.87 ± 0.05) and (3.88 ± 0.05) AE respectively. Low apparent ages at low release temperatures, which are frequently observed in whole rock $^{40}Ar-^{39}Ar$ experiments on lunar basalts, are shown here to be principally due to gas loss in the high-K interstitial glass (quintessence) phase, confirming earlier suggestions. The decrease in apparent ages in the high temperature release previously observed in several total rock samples of Apollo 14 basalts has been identified with the pyroxene. Plagioclase is also found to be the most suitable mineral for the determination of cosmic ray exposure ages, and exposure ages of 280 and 113 million years are found for 14310 and 14073, respectively, indicating that these rocks, which are very similar in many respects, have different exposure histories. The relative production rates of ^{38}Ar from Fe and Ca were determined from a comparison of pyroxene and plagioclase measurements. (auth)

11512 $^{40}Ar-^{39}Ar$ AGES OF APOLLO 14 AND 15 SAMPLES. York, D.; Kenyon, W. J.; Doyle, R. J. (Univ. of Toronto). Geochim. Cosmochim. Acta; Suppl. 3: 1613-1622(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

The $^{40}Ar-^{39}Ar$ method of whole-rock K-Ar dating was applied to the following Apollo 14 material: two samples of fines (14167,9), two samples of basalt 14072,6, two fragments of basalt 14310,65, three basaltic clasts, one micro-breccia clast, and matrix material from breccia 14321,184. For most of the samples a characteristic evolution pattern is seen in which the $^{40}Ar/^{39}Ar$ ratios rise quickly to a plateau around 3.9 b.y. but then display some tendency to drop at about the 50% evolution point. In contrast, basalt 14310 rises to virtually a steady plateau, while the microbreccia clast and the matrix material from 14321 rise quickly to maxima of 4.2-4.3 b.y. and then drop off steadily in staircase fashion with increasing temperature. The results in general indicate a significant event occurred on the moon 3.9 ± 0.1 b.y. ago. Two fragments of Apollo 15 basalt 15555,26 gave an average plateau age of 3.31 ± 0.05 b.y. indicating the existence of a much younger event in the area sampled. Approximate ^{38}Ar cosmic ray exposure ages of 27 m.y., 21 m.y., and 340 m.y. were found for the 14167,9 fines, 14072,6 basalt and 14310,65 basalt, respectively, and 76 m.y. for 15555,26. (auth)

11513 URANIUM AND EXTINCT ^{244}Pu EFFECTS IN APOLLO 14 MATERIALS. Croazaz, G.; Drozd, R.; Graf, H.; Hohenberg, C. M.; Monnin, M.; Ragan, D.; Ralston, C.; Seitz, M.; Shirck, J.; Walker, R. M.; Zimmerman, J. (Washington Univ., St. Louis). Geochim. Cosmochim. Acta; Suppl. 3: 1623-1636 (1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Xenon data from stepwise heating of rock 14301 show a large fission component that is attributed to the decay of ^{244}Pu. A unique feature of 14301 is a clear separation in the release of the fission and spallation components. This allows a determination of the isotopic composition and the derived spectrum is essentially identical with that from spontaneous fission of ^{244}Pu. The total quantity of fission xenon is also ~15 times that expected from ^{238}U spontaneous fission. If the Xe was produced by in situ decay, and if the same initial ratio of Pu/U is assumed as in Pasamonte, then portions of rock 14301 formed no later than 120 m.y. after Pasamonte. Whitlockite crystals in rocks 10057, 12040, 12063, and 12064 contain track densities much higher than expected from either slowing down cosmic rays or ^{238}U spontaneous fission. The anomalous track densities, which are based on total pit counts in the SEM, are shown to be due to spallation recoil tracks. Using an internal isochron method, a value of ~1 t/cm^2/yr is found for the rate of production of spallation tracks during cosmic ray exposure. Using this spallation correction reasonable ages are obtained on the crystalline rock samples. This shows that whitlockite retains tracks under lunar environmental conditions. Spallation and fission tracks can also be separated on the basis of track length distributions measured on plastic replicas, but this method is difficult to apply at high track densities (≥10^6/cm^2). Preliminary data on a whitlockite crystal from 14301 show a large track excess that could be due either to ^{244}Pu or an early irradiation. A phosphate crystal from breccia 14321 has an apparent excess of fission tracks that could also be attributed to ^{244}Pu; however, the situation is confused in both samples by an inhomogeneous distribution of fossil tracks. Whitlockites in rock 14311 have fewer fission tracks than expected indicating a postformation annealing event. (auth)

11514 ^{237}Np, ^{236}U, AND OTHER ACTINIDES ON THE MOON. Fields, P. R.; Diamond, H.; Metta, D. N.; Rokop, D. J.; Stevens,

C. M. (Argonne National Lab., IL). Geochim. Cosmochim. Acta; Suppl. 3: 1637-1644(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Widely varying amounts of ^{236}U (2.4×10^7 y half-life) have been observed in samples 12070,91, 12013,10,42, 12073,34, and 14305,80. In samples 10084,75 and 14163,135 the ratio $^{236}U:^{238}U < 3 \times 10^{-9}$. The $^{236}U:^{238}U$ ratio in the whole 12070 sample is much higher than it is in the coarsest component of that sample. Arguments are presented to show that lunar ^{236}U is produced mostly by solar flare protons irradiating the indigenous ^{238}U. The ^{237}Np (2.14×10^6 y half-life) also predicted by this mechanism was sought and found in sample 12070. Preliminary calculations imply that the solar flare proton flux more than two million years ago was greater than it has been more recently. Measurements of $^{235}U:^{238}U$ mol ratios, total thorium and uranium contents, $^{234}U:^{238}U$ activity ratios, and limits to ^{239}Pu and ^{244}Pu contents were made on samples 14305 and 14163. (auth)

11515 ^{204}Pb IN APOLLO 14 SAMPLES AND INFERENCES REGARDING PRIMORDIAL Pb LUNAR GEOCHEMISTRY. Allen, R. O. Jr.; Jovanovic, S.; Reed, G. W. Jr. (Argonne National Lab., IL). Geochim. Cosmochim. Acta; Suppl. 3: 1645-1650(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

^{204}Pb was measured in Apollo 14 samples and its aqueous (pH 5-6) leachability determined. Soils contain 5-9 ppb of ^{204}Pb with 7-35% leachable; a fragmental rock contains 1.5 ppb ^{204}Pb with ~30% leachable. ^{206}Pb and Bi were also measured in some samples; both were more leachable on the average than ^{204}Pb. Primordial lead is present in two forms, as a volatile, soluble salt on surfaces and as a constituent of a metal or metal related phase. (auth)

11516 ABUNDANCES OF PRIMORDIAL AND COSMOGENIC RADIONUCLIDES IN APOLLO 14 ROCKS AND FINES. Eldridge, J. S.; O'Kelley, G. D.; Northcutt, K. J. (Oak Ridge National Lab., TN). Geochim. Cosmochim. Acta; Suppl. 3: 1651-1658(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Potassium, thorium, uranium, ^{26}Al, and ^{22}Na concentrations were determined nondestructively by gamma-ray spectrometry in a group of breccias or clastic rocks and three samples of fines from Fra Mauro. Samples investigated were rocks 14169, 14170, 14265, 14271, 14272, 14273, 14321,38, and sawdust 14321,256. Fine samples 14148, 14156, and 14149,62 from the top, middle, and bottom, respectively, of the Soil Mechanics Experiment trench were measured in the same study. These samples were collected from the Comprehensive Sample and Station G from the smooth terrain, and from Station C1 in the blocky rim deposit of Cone Crater. There is a remarkable uniformity in the primordial radioelement content in all samples, and average concentrations exceed those of samples returned by Apollo 11 and 12 missions, with the exception of 12034 and 12013. A simple two-component mixing model developed earlier for K/U systematics yields KREEP contents of 60 to 85% for Apollo 14 soils and breccias. Sawdust from extensive cutting of heterogeneous rocks is a valuable sample matrix for many analytical determinations, but dilution by saw-wire contamination must be accurately determined. (auth)

11517 PRIMORDIAL RADIOELEMENTS AND COSMOGENIC RADIONUCLIDES IN LUNAR SAMPLES FROM APOLLO 15. O'Kelley, G. D. (Oak Ridge National Lab., TN); Eldridge, J. S.; Northcutt, K. J.; Schonfeld, E. Geochim. Cosmochim. Acta; Suppl. 3: 1659-1670(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Gamma-ray spectrometers with low background were used to determine nondestructively the concentrations of K, Th, U, and cosmogenic radionuclides in Hadley Base basalts 15016, 15475, and 15495; in breccias 15285 and 15455; and in soils 15031, 15041, 15101, and 15601. Bulk densities were determined for six of the samples. The basalts of Apollo 15 are somewhat lower in K, Th, and U (respectively, about 400, 0.54, and 0.14 ppm) than basalts of Apollo 12 or the low-K basalts of Apollo 11 (about 520, 0.97, and 0.25 ppm). KREEP is ubiquitous in the Apollo 15 soils and breccias and ranges from 8 to 21% in the samples studied. Samples of soil or soil breccia from the mature, relatively undisturbed mare regolith and from the Apennine Front are highest in KREEP, while a sample of soil from the edge of Hadley Rille was significantly lower. Two rocks have concentrations of ^{26}Al less than their saturation values; 15475 and 15495 may have been ejected onto the lunar surface as recently as 0.7 m.y. and 2.0 m.y. ago, respectively. Trench samples from the LM-ALSEP site show variations in radionuclide concentrations with depth similar to those of the Apollo 12 cores. The galactic cosmic-ray production rate of ^{48}V was determined as 57 ± 11 dpm/kg Fe. The concentration of ^{56}Co in rock 15016 leads to the conclusion that the solar flare of January 24, 1971 was 1.91 ± 0.45 times more intense than the flare of November 3, 1969, in agreement with other radiochemical data and with preliminary satellite measurements. (auth)

11518 LUNAR SURFACE PROCESSES AND COSMIC-RAY CHARACTERIZATION FROM APOLLO 12-15 LUNAR SAMPLE ANALYSES. Rancitelli, L. A.; Perkins, R. W.; Felix, W. D.; Wogman, N. A. (Battelle Pacific Northwest Labs., Richland, WA). Geochim. Cosmochim. Acta; Suppl. 3: 1681-1691(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

The Apollo 14 samples; 14310,187, 14321,0, and 14163,0 and the Apollo 15 samples 15205,0, 15206,0, 15211,2, 15221,2, 15231,1, 15091,15, 15261,15, 15271,19, 15031,14, 15041,14, 15501,2, 15505,0, 15535,0, 15557,1, and 15556,0 were analyzed for their cosmogenic and primordial radionuclide contents. Samples from two stations at the Apollo 15 Hadley Apennine site were shown to have lunar surface exposure ages of less than one million years based on ^{26}Al undersaturation. Two chips, 15205 and 15206, from a meter-sized boulder at Station 2 indicated the boulder had been ejected during a cratering incident about three-fourths of a million years ago. A soil clod from a 15 meter diameter crater and a breccia at Station 9 showed similar short exposure ages. Measurements of ^{56}Co (77d) established that the proton flux above 10 MeV from the January 24, 1971 flare was about 1.4×10^9 protons per cm^2 while ^{48}V measurements indicated that the galactic flux is not significantly different between 1 and 2 AU. The solar-flare proton energy distribution determined from the depth concentration gradients of both ^{26}Al and ^{22}Na is in accord, indicating constancy of the solar-flare energy spectrum for the past few million years. The primordial radionuclide concentrations at the Apollo 15 site show a local range in concentrations comparable to the total concentration range from the previous Apollo landing sites. (auth)

11519 COSMIC-RAY PRODUCED RADIOISOTOPES IN APOLLO 12 AND APOLLO 14 SAMPLES. Begemann, F.; Born, W.; Palme, H.; Vilcsek, E.; Waenke, H. (Max-Planck-Institut fuer Chemie, Mainz). Geochim. Cosmochim. Acta; Suppl. 3: 1693-1702(1972).

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Results are reported for the ^{14}C-, ^{22}Na-, ^{26}Al-, ^{36}Cl-, and ^{39}Ar-content of three lunar fines (12001, 14163, 14259) and three different depth regions in the igneous rock 12053. ^{22}Na and ^{26}Al show the expected solar proton induced excess over the galactic cosmic ray produced levels. For the soil samples they allow qualitative statements about the mean sampling depth. The ^{14}C-data represent the first depth profile of this isotope in a lunar sample. The observed gradient is not reconcilable with a mean flux of 100 solar protons/cm^2 sec and $R_0 \approx 100$ MV. Instead, a 3-5 times higher flux is necessary or the presence of a surface correlated component. It is tentatively suggested that the required flux of 1×10^{-3} ^{14}C-atoms/cm^2 sec as well as the tritium flux of 5×10^{-3} $^3H/cm^2$ sec discussed by D'Amico et al. is due to (n,p)-reactions of secondary neutrons on the surface of the sun. Two grain size fractions of the 12001 soil were found to contain approximately equal amounts of ^{22}Na, ^{26}Al, and ^{36}Cl but grossly different ^{39}Ar-activities. The data point to an almost complete loss of ^{39}Ar from the Ca-containing phases in the fine-grained fraction. The ^{36}Cl- and ^{39}Ar-data obtained on rock 12053 as well as all others on rock samples available in the literature are discussed. The discrepancies between the predicted depth profiles and the measured ones are ascribed to the small size of the rocks analyzed. Model calculations for infinite flat surfaces neglect the enhanced flux of solar protons with ranges comparable to the rock radii. (auth)

11520 ARGON, RADON, AND TRITIUM RADIOACTIVITIES IN THE SAMPLE RETURN CONTAINER AND THE LUNAR SURFACE. Stoenner, R. W.; Lindstrom, R. M.; Lyman, W.; Davis, R. Jr. (Brookhaven National Lab., Upton, NY). Geochim. Cosmochim. Acta; Suppl. 3: 1703-1717(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

The radioactive rare gases ^{37}Ar (35 day), ^{39}Ar (269 yr), ^{222}Rn (3.8 day), and tritium (12.3 yr) were measured in the gas recovered from the Apollo 12, 14, and 15 sample return containers and in lunar rocks and soil. The activities observed in the sample return containers can be attributed to the diffusion of these activities from the fine material present in the box. An analysis of these results and the diffusion of argon activities and tritium from lunar fine material at various temperatures up to 900°C allows a determination of the heat of diffusion and the diffusion constant divided by the square of the mean grain size (D/a^2) for

lunar material. An analysis is made of the loss of argon into the lunar atmosphere. The cosmic ray production of ^{37}Ar, ^{39}Ar, and tritium in the lunar soil was measured in two deep samples, and in adjacent surface samples from the Apollo 15 mission. The ^{37}Ar activity was essentially the same at the surface and at depth (150 g/cm^2). This result is in accord with a 600-MeV proton bombardment of a thick target of lunar-like composition 100 g/cm^2 deep. Argon-37 activities from the Apollo 14 mission were high as a result of the January 1971 flare that occurred 12 days preceding the mission. Measurements of the ^{222}Rn observed in the sample return container allow a determination of the ^{222}Rn emanation rate in lunar soil under conditions representative of the natural conditions on the moon. An analysis of the emanation rate permits an estimate of the amount of ^{222}Rn released to the lunar atmosphere. (auth)

11521 COSMOGENIC NUCLIDES IN FOOTBALL-SIZED ROCKS. Wahlen, M.; Honda, M.; Imamura, M.; Fruchter, J. S.; Finkel, R. C.; Kohl, C. P.; Arnold, J. R.; Reedy, R. C. (Univ. of California, San Diego, La Jolla). Geochim. Cosmochim. Acta; Suppl. 3: 1719-1732(1972).

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Short- and long-lived radionuclides were measured in rock 14321 at depths of ~0.3 g/cm^2, ~1.1 g/cm^2, 18 g/cm^2, and 40 g/cm^2. The effects of solar cosmic rays are seen in the upper samples of 14321. After correcting for an attrition to the rock (loss of surface material in handling) of (0.4 ± 0.2) mm, the ^{56}Co measurements imply, for the flare of January 24, 1971, a J (>10 MeV) of 200 protons/cm^2 sec (4π) averaged over the mean life of ^{56}Co and an R_0 (exponential rigidity parameter) of 100 MV, in good agreement with satellite data (Bostrom et al.). The ^{55}Fe and ^{22}Na values, which average over many flares, are consistent with our rock 12002 measurements (Finkel et al.). The near surface profiles of the longer-lived isotopes, ^{53}Mn and ^{26}Al, suggest an erosion rate of about 2 mm/10^6 yr. ^{54}Mn, ^{36}Cl, and ^{10}Be were also measured in 14321. ^{55}Fe, ^{10}Be, and ^{53}Mn were measured in a slice of rock 14310 from 24 g/cm^2 average depth. This sample was also separated into two density fractions enabling the production rates for ^{22}Na, ^{36}Cl, and ^{26}Al from different target elements to be determined. The activities in the sample of 14310 and in the deepest sample of 14321 have no contribution from solar cosmic rays and give the beginning of the galactic cosmic-ray depth profile. A brief comparison between the data and the Reedy-Arnold model (Reedy and Arnold) is discussed. ^{56}Co, ^{22}Na, ^{26}Al, and ^{53}Mn was also measured in a sample of soil 14259. The observed solar cosmic ray produced activities are consistent with an average depth for the soil sample of 1 cm (1.8 g/cm^2). (auth)

11522 COSMONUCLIDES IN LUNAR ROCKS. Yokoyama, Y.; Auger, R.; Bibron, R.; Chesselet, R.; Guichard, F.; Leger, C.; Mabuchi, H.; Reyss, J. L.; Sato, J. (CNRS, Gif-sur-Yvette, France). Geochim. Cosmochim. Acta; Suppl. 3: 1733-1746 (1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

The rates of production of cosmonuclides as a function of depth in the moon are calculated with a simplified method. The differential spectra of particles due to galactic cosmic ray and of solar protons are calculated as a function of depth. For solar protons, the range-energy relation of Wilson is used. For galactic cosmic rays, a three-steps cascade model is used. Integration as a function of incident angle is simplified by dividing zenith angles to have an equal solid angle. The calculated production rates are compared with experimental results and with the earlier calculations. Th, U, ^{26}Al, and ^{55}Fe are measured in lunar rock 14305. (auth)

11523 RADIOACTIVITIES IN RETURNED LUNAR MATERIALS. Fireman, E. L.; D'Amico, J.; DeFelice, J.; Spannagel, G. (Smithsonian Institution, Cambridge, MA). Geochim. Cosmochim. Acta; Suppl. 3: 1747-1762(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

The ^3H, ^{37}Ar, and ^{39}Ar radioactivities were measured at several depths in the large documented lunar rocks 14321 and 15555. The comparison of the ^{37}Ar activities from similar locations in rocks 12002, 14321, and 15555 gives direct measures of the amounts of ^{37}Ar produced by the 2 November 1969 and 24 January 1971 solar flares. From the ^{37}Ar measurements, the intensities of the 2 November 1969 and 24 January 1971 solar flares were estimated to be (5.1 ± 1.2) × 10^6 and (5.9 ± 1.0) × 10^6 protons (> 50 MeV)/cm^2 sr, respectively. Because of the large differences in the K and Fe contents of the documented rocks, the ^{39}Ar produced from the separate target elements, Fe + Ti, K, and Ca, at 1-, 5-, and 12-cm depths was obtained from the ^{39}Ar measurements. The high-energy proton flux (> 200 MeV) averaged over 1000 yr was obtained from the Fe + Ti → ^{39}Ar; the neutron flux (≳1 MeV) averaged over 1000 yr was obtained from the K → ^{39}Ar; and the neutron flux (≳10 MeV) averaged over 1000 yr was obtained from the Ca → ^{39}Ar. From the depth dependence of ^{39}Ar, the intensity of solar-flare protons (> 50 MeV) averaged over the past 1000 yr was estimated to be 7 × 10^8/cm^2 yr. The tritium contents in the documented rocks decreased with increasing depth. The solar-flare intensity averaged over 30 yr obtained from the tritium depth dependence was approximately the same as the flare intensity averaged over 1000 yr obtained from the ^{39}Ar measurements. Radioactivities in two Apollo 15 soil samples, ^3H in several Surveyor 3 samples, and tritium and radon weepage were also measured. (auth)

11524 STUDY ON THE COSMIC-RAY PRODUCED LONG-LIVED ^{53}Mn IN APOLLO 14 SAMPLES. Herr, W. (Univ., Cologne); Herpers, U.; Woelfle, R. Geochim. Cosmochim. Acta; Suppl. 3: 1763-1769(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Accurate determinations of long-lived spallation nuclides are of current interest for the estimation of "radiation ages," depth profiles, and for the detection of possible variations in the cosmic flux. With respect to the previous unsatisfactorily known ^{53}Mn half-life, a redetermination of the ^{53}Mn-neutron cross section was done. Having irradiated meteoritic Mn for 392 days in a high neutron flux it was found that σ_{therm} = 66 ± 7 barns. Based on the "Peace River" chondrite, the ^{53}Mn content of which is well known; a product of T × σ = (260 ± 32) × 10^6 barns × years was derived, thus leading to a ^{53}Mn half-life of (3.9 × 0.6) × 10^6 years. On the basis of this figure a number of Apollo 11 to 14 soil and rock samples were analyzed by neutron activation techniques for their ^{53}Mn contents. The K-emitter ^{53}Mn is converted by neutron capture to the γ-emitting ^{54}Mn, which is sensitively detected by a 75 cc Ge(Li) well-type detector. The surface soil 14259 (comprehensive) with 644 dpm/kg Fe was found to be twice as high in ^{53}Mn as the bulk soils. The ^{53}Mn-depth effect on rock 10017 was reestablished. From the respective low value of the microbreccia 14305 (interior), pointing out that "saturation" activity is not reached, a remarkable short exposure age in the order of ~6 million years is concluded. (auth)

11525 ALPHA SPECTROMETRY OF A SURFACE EXPOSED LUNAR ROCK. Lambert, G.; Grjebine, T.; Le Roulley, J. S.; Bristeau, P. (CRNS, Gif-sur-Yvette, France). Geochim. Cosmochim. Acta; Suppl. 3: 1771-1777(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

The α activity of the top surface of a Moon rock was measured in order to detect an eventual layer of ^{210}Pb and ^{210}Po that could be designated as descendant of the radon escaping from the lunar soil. The limit for this activity is proposed as 2 × 10^{-5} dis/sec/cm^2. The possibility for the existence of this process was meanwhile shown in a simulating experiment. The absence of the activity can be attributed to an apparently very low transmission coefficient of fines. This is also seen in another simulation experiment where a source emanating radon is covered with increasing layers of basalt powder. (auth)

11526 VANADIUM ISOTOPIC COMPOSITION AND THE CONCENTRATIONS OF IT AND FERROMAGNESIAN ELEMENTS IN LUNAR MATERIAL. Rey, P. (Purdue Univ., Lafayette, IN); Balsiger, H.; Lipschutz, M. E. Geochim. Cosmochim. Acta; Suppl. 3: 1779-1786(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

The isotopic composition of vanadium from three Apollo 14 samples, an Apollo 11 sample, the dark portion of a gas-rich chondrite and a standard rock are the same as that of previous lunar, meteoritic, and terrestrial samples within the limits of error. The maximum difference possible between the mean isotopic composition in lunar and meteoritic material is about 1‰. The concentrations of iron, magnesium, titanium, chromium, and vanadium and the weight ratios of the first four of these elements to vanadium in Apollo 12 and 14 lunar materials suggest different primary source materials for different inclusions in rock 14321. (auth)

11527 RARE-GAS ANALYSES ON NEUTRON IRRADIATED APOLLO 12 SAMPLES. Alexander, E. C. Jr.; Davis, P. K.; Reynolds, J. H. (Univ. of California, Berkeley). Geochim. Cosmochim. Acta; Suppl. 3: 1787-1795(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Argon, krypton, and xenon from stepwise heating of five Apollo 12 rocks that had been irradiated to a neutron fluence of ~10^{19} neutrons/cm^2 were analyzed mass-spectrometrically. The

$^{40}Ar-^{39}Ar$ ages were determined and ranged from $3.18 \pm 0.06 \times 10^9$ years to $3.32 \pm 0.06 \times 10^9$ years. Trace elements Ba, Br, I, and U were measured via the neutron induced reactions that produce isotopes of krypton and xenon. The following concentration ranges were observed: Ba, 46 to 70 ppM; Br, 48 to 146 ppB; I, 16 to 73 ppB; and U, 170 to 247 ppB. (auth)

11528 NOBLE GAS STUDIES ON REGOLITH MATERIALS FROM APOLLO 14 AND 15. Bogard, D. D.; Nyquist, L. E. (Manned Spacecraft Center, Houston, TX). Geochim. Cosmochim. Acta; Suppl. 3: 1797-1819(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Abundances and isotopic compositions of He, Ne, Ar, Kr, and Xe were determined in a number of Apollo 14 and 15 samples, including bulk analyses on soils and breccias, a range of depths in a trench and a core, and grain size separates and stepwise temperature releases of Apollo 14 bulk fines. Several samples exhibit measured values of $^{84}Kr/^{36}Ar \simeq 3 \times 10^{-4}$ and $^{132}Xe/^{36}Ar \simeq 0.4 \times 10^{-4}$, and set new upper limits for these ratios in the solar wind. A few samples indicate a trapped Ne other than solar wind Ne with $^{20}Ne/^{22}Ne \leq 11.4$. Trapped solar wind, $^{20}Ne/^{22}Ne$ (12.65 ± 0.10), and $^{36}Ar/^{38}Ar$ (5.36 ± 0.03) obtained from grain size separates and stepwise temperature release data are identical to values found for Apollo 11 and 12; $^4He/^3He$ is variable (2000-2800). Both He and Ne exhibit a low-temperature enhancement of $^3He/^4He$ and $^{20}Ne/^{22}Ne$ which may be due to a lunar atmosphere implanted component. Trapped $^{40}Ar/^{36}Ar$ is variable among a number of samples. Low-temperature releases reveal a Kr component distinct from the cosmic ray spallation component defined by high temperature releases and grain size separates, and for which $^{82}Kr/^{86}Kr$, $^{83}Kr/^{86}Kr$, and $^{84}Kr/^{86}Kr$ are enriched over typical trapped values by up to 29%, 21%, and 3%, respectively. This low-temperature component is apparently not due to implantation of lunar atmosphere Kr, but may result from solar flare reactions on Rb. Xe isotope correlation diagrams for stepwise temperature releases and grain size separates exhibit linear correlations of slightly different slope, which apparently are not caused by mass fractionation during the stepwise heating. For both Kr and Xe, grain size separates and temperature releases above 900°C indicate different trapped components, which may be related as mixtures of trapped solar wind and other low temperature components. Spallation $^{131}Xe/^{126}Xe$ in many fines and gas-rich breccias varies by a factor of two, while $^{124}Xe/^{126}Xe$ is essentially constant at 0.53 ± 0.02. If much of the excess ^{131}Xe is due to neutron capture on Ba, the variations in spallation $^{131}Xe/^{126}Xe$ possibly indicate differences in average shielding. By this criterion, samples from core 14230 and the Apollo 14 trench samples show nearly the same average burial depth during cosmic ray exposure, the topmost samples having marginally greater $^{131}Xe/^{126}Xe$. A number of soils and breccia show differences in spallation xenon of ≥ a factor of three, indicating variable exposure times. (auth)

11529 TRAPPED SOLAR-WIND NOBLE GASES IN APOLLO 12 LUNAR FINES 12001 AND APOLLO 11 BRECCIA 10046. Eberhardt, P. (Univ., Bern); Geiss, J.; Graf, H.; Groegler, N.; Mendia, M. D.; Moergeli, M.; Schwaller, H.; Stettler, A.; Kraehenbuhl, U.; von Gunten, H. R. Geochim. Cosmochim. Acta; Suppl. 3: 1821-1856(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

The concentrations and isotopic composition of the five noble gases were measured in an unseparated bulk sample of the Apollo 12 fines 12001, in seven bulk and five ilmenite grain size fractions from 12001 and in four ilmenite grain size fractions separated from the Apollo 11 breccia 10046. In addition, we determined Sr, Zr, Ba, La, Ce, Sm, and Eu in several bulk grain size fractions from 12001. (LBS)

11530 INERT GASES FROM APOLLO 12, 14, AND 15 FINES. Heymann, D.; Yaniv, A.; Lakatos, S. (Rice Univ., Houston, TX). Geochim. Cosmochim. Acta; Suppl. 3: 1857-1863(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

He and Ne contents have been determined in five Apollo 14, five Apollo 12, and two Apollo 15 samples (Ar data are presented in the following paper). Kr and Xe contents were measured in all but the two Apollo 15 samples. The two "mini-rocks" from 14166 and 14167 contain radiogenic ^3He_R. Their apparent U, Th-^4He age, and in fact that of all the Apollo 14 fines is 3700 ± 800 m.y. If this age is real then it follows that either the (<1 mm) ejecta from Cone Crater (about 1 km away) lost little if any ^4He_R during the formation of the crater, or that these ejecta constitute only a small proportion in the bulk, contingency, and comprehensive fines. The ^3He_C radiation ages of 14003, 14163, and 14259 are about 300 m.y.; the $^{21}Ne_C$ ages are about 400, 400, and 300 m.y., respectively. The $^{21}Ne_C$ age of 15601 is about 350 m.y. (auth)

11531 RARE GAS RECORD OF APOLLO 14 AND 15 SAMPLES. Kirsten, T.; Deubner, J.; Horn, P.; Kaneoka, I.; Kiko, J.; Schaeffer, O. A.; Thio, S. K. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Geochim. Cosmochim. Acta; Suppl. 3: 1865-1889(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Rare gases have been measured in numerous samples from Apollo 14 and 15 returns including bulk soils, individual soil grains, 10-50 mg rock fragments from the soil, clasts, pieces of breccia, and pieces of large crystalline rocks. Some of the samples were irradiated with fast neutrons before analysis, allowing a determination of $^{39}Ar-^{40}Ar$ crystallization ages and $^{37}Ar-^{38}Ar$ cosmic ray exposure ages. The ages show that the Fra Mauro formation at the Apollo 14 landing site contains mainly debris from the pre-Mare Imbrium terrain, with some fragments from neighboring maria and that there has been igneous activity at the pre-Mare Imbrium site for over 200 m.y. from 3.8 to 4.0×10^9 years ago. Exposure ages are found to lie between 15 m.y. and 770 m.y. for the rocks. Individual soil grains give ages as high as 1700 m.y. These ages reflect the gardening of the lunar soil. As the solar wind component in the soil is similar at all sites, it is inferred that the retained solar wind may be very ancient, possibly up to 4.0×10^9 years. Some single grains contain solar wind very little changed by diffusion. Several anomalies exist, the Ne is enriched in 15421 soil from near Spur Crater and the abundance ratio of "parentless" ^{40}Ar relative to implanted ^{36}Ar is variable and can be as high as 8. (auth)

11532 EXPOSURE AGES AND NEUTRON CAPTURE RECORD IN LUNAR SAMPLES FROM FRA MAURO. Lugmair, G. W.; Marti, K. (Univ. of California, San Diego, La Jolla). Geochim. Cosmochim. Acta; Suppl. 3: 1891-1897(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Cosmic-ray exposure ages of Apollo 14 rocks and rock fragments obtained by the $^{81}Kr-^{83}Kr$ method range from 27 to 700 million years. Rock 14321, collected near the Cone crater rim, is one of the many ~27 m.y. old ejecta which were reported at the Third Lunar Science Conference. All the other rocks have considerably higher exposure ages. Isotopic anomalies from neutron capture in gadolinium, in bromine and in barium are used to obtain information on the lunar neutron spectrum at various depths below the lunar surface. The flux ratio of resonance and slow (<0.3 eV) neutrons is found to be nearly constant in the topmost ~100 g/cm^2. (auth)

11533 CLASSIFICATION AND SOURCE OF LUNAR SOILS; CLASTIC ROCKS; AND INDIVIDUAL MINERAL, ROCK, AND GLASS FRAGMENTS FROM APOLLO 12 AND 14 SAMPLES AS DETERMINED BY THE CONCENTRATION GRADIENTS OF THE HELIUM, NEON, AND ARGON ISOTOPES. Megrue, G. H.; Steinbrunn, F. (Smithsonian Institution, Cambridge, MA). Geochim. Cosmochim. Acta; Suppl. 3: 1899-1916(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Concentration gradients of the helium, neon, and argon isotopes from various lunar materials were determined in situ by laser probe-mass spectrometry. The results demonstrate that many lunar glasses, soil agglomerates, and breccias contain solar gases throughout the grains at a depth greater than their expected range of a few microns. The element ratios of the solar gases are used to classify uniquely lunar soil, agglomerates, and breccias. No evidence for thermal diffusion of radiogenic ^4He and ^{40}Ar has been found in the profile analysis of one norite (KREEP) fragment. The potassium concentrations of 13 glasses correlate with $^{40}Ar/^{36}Ar$, $^4He/^{20}Ne$, and $^4He/^{36}Ar$ with coefficients of 0.98, 0.81, and 0.78, respectively, which clearly demonstrate the close affinity of radiogenic ^4He and ^{40}Ar. Furthermore, $^4He/^3He$, $^4He/^{20}Ne$ variations are shown to result from differing radiogenic ^4He abundances. K-Ar ages of the glasses in the Apollo 14 regolith indicate that melting events occurred at 17 m.y., <600 m.y., and 2 to 2.6, and 3.2 to 3.7×10^9 yr. Cosmic-ray exposure ages <40 m.y. and the high frequency of soil agglomerates in the lunar regolith similar to breccia 14047 indicate that breccias 14047 and 14321 were put on the lunar surface quite recently and most likely are derived from the formation of Cone Crater. Breccia 14301, which contains an abnormally high radiogenic ^{40}Ar within the matrix, is similar to the chemistry and inferred structure of the Fra Mauro formation. A fragment within this breccia has an exposure age of 200 m.y. The analyses show no evidence for reimplanted ^{40}Ar onto the surface of lunar grains by solar-wind irradiation. (auth)

11534 ISOTOPIC ANOMALIES IN LUNAR RHENIUM. Michel, R.; Herpers, U.; Kulus, H.; Herr, W. (Univ., Cologne). Geochim. Cosmochim. Acta; Suppl. 3: 1917-1925(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Apollo 14 soils 14163 (bulk) and 14259 (comprehensive) and breccias from 14321 and 14305 were analyzed for their Re and W contents. Simultaneously, the Re isotopic composition was determined by means of neutron activation. The latter was achieved by comparing the 137 keV line of ^{186}Re with the 155 keV line of ^{188}Re. The Apollo 14 soils were considerably enriched in Re (0.95 to 1.4 ppB) relative to basaltic rocks (0.01 to 0.09 ppB for Apollo 12). The higher abundance is explained by a stronger contribution of a meteoritic component, about twice as intensive as that at the Apollo 12 landing place. Tungsten behaves in a similar way (Apollo 14 soils: 1.3 to 1.9 ppM, in contrast to basaltic rock 12021 with only 0.28 ppM W). It was also established that the ^{187}Re is enriched in lunar material relative to the terrestrial value by 1.4 to 1.8% (in 14 regoliths) and by as much as 29% in one of the breccias. The W/Re ratios varied between 1,100 (soils) and 41,000 (breccia 14321). Thus suggesting that the isotopic anomaly is mainly caused by neutron capture in ^{186}W resulting in a surplus of ^{187}Re. However, it should be pointed out, that neutron capture in ^{186}W has taken place not only on the Moon, but also in the course of the analytical procedure. Therefore the excess of ^{187}Re has to be corrected for the effect of enhancement from the "terrestrial" pile neutrons. This was done by calculation and comparison with suitable Re and W standards. The lunar neutron contribution is between 20 and 60% of the total excess and is considered to be primarily due to epithermal neutrons up to ~100 eV. (auth)

11535 COMPARISON OF NOBLE GASES RELEASED FROM LUNAR FINES (15601.64) WITH NOBLE GASES IN METEORITES AND IN THE EARTH. Srinivasan, B.; Hennecke, E. W.; Sinclair, D. E.; Manuel, O. K. (Univ. of Missouri, Rolla). Geochim. Cosmochim. Acta; Suppl. 3: 1927-1945(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

The abundance and isotopic composition of helium, neon, argon, krypton, and xenon which had been released by stepwise heating of lunar soil (15601,64) were measured mass spectrometrically. The extraction temperatures ranged from 100°C to 1500°C in 100° intervals. The bulk of the noble gases were released between 700°C and 1500°C, and the release pattern over this temperature range showed a preferential release of the lighter weight noble gases at low extraction temperatures. This release pattern was also observed across the isotopes of the individual noble gases. Very little gas was released below 700°C, but the gas release pattern from the very low extraction temperatures was unlike the general release trend, showing an enrichment of the heavier noble gases. This anomalous release pattern at low extraction temperatures ($T \leq 700$°C) was also observed across the isotopes of individual noble gases and is attributed to one, or a combination, of two effects: (a) adsorption of atmospheric gases on the lunar soil during its residence on Earth, or (b) selective release of the lighter weight noble gases from the low-temperature sites of lunar soil during its residence on the lunar surface. Isotopic release patterns of noble gases from lunar soil are compared with atmospheric and meteoritic noble gases. The results indicate that major differences between the isotopic composition of He, Ne, Ar, and Kr in terrestrial, meteoritic and lunar samples can be accounted for by a combination of mass fractionation and in situ nuclear processes in solid planetary material. However, it is evident that additional processes, perhaps nuclear reactions in the Sun, have altered the isotopic composition of xenon. Relative to fractionated atmospheric xenon the spallation-free xenon in lunar fines appears to be enriched in the heavy isotopes, ^{134}Xe and ^{136}Xe, and depleted in ^{124}Xe and ^{129}Xe. (auth)

11536 THERMAL RELEASE OF HELIUM, NEON, AND ARGON FROM LUNAR FINES AND MINERALS. Baur, H.; Frick, U.; Funk, H.; Schultz, L.; Signer, P. (Swiss Federal Inst. of Tech., Zurich). Geochim. Cosmochim. Acta; Suppl. 3: 1947-1966(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

He, Ne, and Ar from (1) grain-size fractions of bulk lunar soils (10084,48; 14163,166; 15101,88; 15321,54) and (2) sieved mineral separates of lunar soil 14163,166 were studied in stepwise and linear heating experiments. The gases were monitored continuously during release in a specially constructed system. The results are compared to simulation experiments and model predictions. The release patterns of He, Ne, and Ar from different grain size fractions of bulk soils appear to be quite similar. The He, Ne, and Ar retentivities of the separated minerals are different: (in increasing order) plagioclase, magnetic glass, pyroxene. Diffusive alteration of the implantation profiles is detected and correlates with the degree of retentivity. Comparison of simple model calculations with release patterns of gases implanted as ions with energies in the keV region has met with only limited success in that certain portions, but not the totality, of the observed release profiles can be described. Particularly intractable in this regard are (1) the low temperature enhancement observed in most release patterns and (2) the shape of the high temperature release, which may (in some cases) be an earmark of release of gas from greater than normal penetration depths. Only minor amounts of ^{40}Ar were detected in the low temperature release range, a feature that will require reexamination of theories which ascribe "orphan" ^{40}Ar to a low energy retrapping of ^{40}Ar from the lunar atmosphere. Detailed consideration of the results have led to a search for additional sources of "orphan" ^{40}Ar. (auth)

11537 ATMOSPHERE ^{40}Ar IN LUNAR FINES. Yaniv, A.; Heymann, D. (Rice Univ., Houston, TX). Geochim. Cosmochim. Acta; Suppl. 3: 1967-1980(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

The criticism by Baur et al. of the solar wind implantation mechanism of atmospheric (lunar) ^{40}Ar, which is mainly based on thermal release studies of argon isotopes from sample 14163, is rebutted. The solar wind mechanism could produce atmospheric ^{40}Ar ions with kinetic energies comparable to those of typical solar-wind ^{36}Ar ions if the magnetic field near the moon was stronger in the past than it is today or if the average solar wind velocity was greater in the past than it is today. The ^{40}Ar/^{36}Ar ratio tends to become smaller for "younger" regolith. One interpretation is that the concentration of neutral ^{40}Ar in the moon's atmosphere decreased between 4000 and 3000 m.y. ago. The trend suggests that most of the atmospheric ^{40}Ar now seen in fines was trapped before 3000 m.y. ago and that the concentration of neutral ^{40}Ar in the lunar atmosphere had become very small by the time of the Copernican event, 850 m.y. ago. Hence, calculations of the kinetic energies of atmospheric ^{40}Ar ions with today's values of solar wind velocities and near-lunar magnetic field values could be irrelevant. The preservation of small-scale ^{40}Ar provinces within the Apollo landing sites probably reflects the ejecta blankets of sporadic relatively recent impacts in the areas. These blankets apparently were not greatly disturbed after they formed. The regolith seems to be quite inhomogeneous both vertically as well as horizontally. The Apollo 15 fines apparently do not agree with the ^{40}Ar/^{36}Ar versus age trend. The reason for this is not known at this time. (auth)

11538 VOLATILIZED LEAD FROM APOLLO 12 AND 14 SOILS. Doe, B. R.; Tatsumoto, M. (Geological Survey, Denver). Geochim. Cosmochim. Acta; Suppl. 3: 1981-1988(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Lead has been volatilized from lunar soils 12033, 12070, and 14259 under vacuum at the following temperature intervals: 0°-600°, 600°-800°, 800°-1000°, and 1000°-1350°C. These studies confirm observations on previous volatilizations from soils 10084 and 12070 by Silver (1970, 1971) and Huey et al. (1971) that ^{208}Pb/^{204}Pb progressively increases and ^{207}Pb/^{206}Pb progressively decreases in the temperature range 600°-1000°C. In addition, it was found that the lead released from the three soils has values of ^{207}Pb/^{206}Pb in the range 0.57-0.59 in the 1350°C fraction, independent of whether the values for this ratio are greater or less than this value in the lower temperature fractions. Values of ^{208}Pb/^{206}Pb generally decrease from the 600°C to the 1350°C fractions from as great as 2 to as little as 0.7. These 1350°C fraction data suggest the presence of a highly refractory phase in the soils that may be about 4500 m.y. in age and that appears to have values of Th/U (~2.8-3.6), as calculated from ^{208}Pb/^{206}Pb, that are less than those for the whole-soil (Th/U ~ 3.7-3.9). The data that are available on Th/U in individual minerals from the studies by Burnett et al. (1971) and Haines et al. (1971, 1972) suggest that the highly refractory phase may be Zr-Ti minerals such as tranquilityite. Volatilization data for soils 12033 and 14259 in the temperature range 600°-1000°C suggest a Pb-Pb secondary isochron "age" of about 4200 m.y. and indicate that the value of ^{238}U/^{204}Pb in these temperature fractions in the interval between about 4500 and 4200 m.y. was about 1000 for soil 14259 but more on the order of 100 for soil 12033. (auth)

11539 TRACE ELEMENT RELATION BETWEEN APOLLO 14 AND 15 AND OTHER LUNAR SAMPLES, AND IMPLICATIONS OF A MOON-WIDE C1-KREEP COHERENCE AND Pt-METAL NON-COHERENCE. Reed, G. W. Jr.; Jovanovic, S.; Fuchs, L. (Argonne National Lab., IL). Geochim. Cosmochim. Acta; Suppl. 3: 1989-2001(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

The halogen, Hg, Ru, Os, U, Li, and Te contents in Apollo 14 soils 14259 and 14163, fragmental rocks 14321 and 14305, crystalline rock 14310, and some Apollo 15 soils are given. Br con-

centrations as high as 1 ppm are observed for the first time. The Cl remaining after aqueous leaching of samples is correlated with the total P_2O_5 in soils from all sites. Ru and Os are not coherent with the other Pt-metals, nor with each other; a lunar fractionation process appears to be necessary. (auth)

11540 THERMAL VOLATILIZATION STUDIES ON LUNAR SAMPLES. Gibson, E. K. Jr.; Hubbard, N. J. (Manned Spacecraft Center, Houston, TX). Geochim. Cosmochim. Acta; Suppl. 3: 2003-2014(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Thermal volatilization studies on lunar basalts, breccias, and soil have been carried out to measure the depletion of selected elemental abundances during heating under vacuum. The study revealed that the easily volatilized alkali element Rb is lost from lunar samples at temperatures of 950°C or less. The alkali elements K and Na are lost at higher temperatures while the refractory elements (Li, Ba, Sr, REE) are not volatilized below 1400°C. The vaporization temperature of Na in basaltic lunar samples is near 1050°C and Na is slowly lost from Apollo 14 soil at 1050°C. This study indicates that thermal volatilization of basaltic lunar materials is restricted to selected alkali elements and other elements of similar or greater volatility. The naturally occurring changes in K/Rb and K/Ba ratios of KREEP breccia and glass samples have been duplicated during laboratory heating experiments at 1050°C and indicate that some KREEP breccias have been subjected to a metamorphic event with temperatures of 1050°C or below. The kinetics of K, Rb, and Pb loss are sufficiently fast that these elements can be vaporized and lost during production of impact glasses, and in fact vapor deposited K, Rb, and Pb have been found in lunar soils by other investigators. It is improbable that lunar basalt flows have lost a significant percentage of K, Rb, and Na by volatilization unless the flow was extensively stirred. The uniformly low Na concentrations of mare basalts are not caused by post eruption vaporization and loss of Na. (auth)

11541 INORGANIC GAS RELEASE AND THERMAL ANALYSIS STUDY OF APOLLO 14 AND 15 SOILS. Gibson, E. K. Jr. (Manned Spacecraft Center, Houston, TX); Moore, G. W. Geochim. Cosmochim. Acta; Suppl. 3: 2029-2040(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Inorganic gas release studies were made on Apollo 14 and Apollo 15 soils. The samples were heated at 6°C/min to 1400°C under vacuum, and the abundances, temperature ranges, and sequences of released gases were determined. The gases measured included H_2, He, H_2O, CO, N_2, O_2, H_2S, CO_2, and SO_2. The evolved gases are from several sources: (1) atmospheric contaminants, (2) solar wind derived species, (3) chemical reaction products, and (4) gases from vesicles and inclusions and/or gases exsolving from the melt. Soil samples lost less than 1.7 wt. % when heated to 1400°C under vacuum, while a sample heated in air to 1400°C gained 4.8 wt. %. Initial melting of the Apollo 14 bulk soil and two Apollo 15 soils occurs at 1140 ± 20°C. Proton irradiation experiments with 100 keV protons were carried out on samples of terrestrial olivine in an attempt to produce low molecular weight species which might be generated from solar wind irradiation of lunar samples. Irradiated samples of olivine contain 300 ppm H_2O above the control samples. The quantity of water produced and its temperature release profile is similar to that found in some lunar samples. (auth)

11542 TOTAL NITROGEN CONTENTS OF SOME APOLLO 14 LUNAR SAMPLES BY NEUTRON ACTIVATION ANALYSIS. Goel, P. S.; Kothari, B. K. (Indian Inst. of Tech., Kanpur). Geochim. Cosmochim. Acta; Suppl. 3: 2041-2050(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Total nitrogen was measured by neutron activation in one basaltic rock, one fines sample, and several breccias from Apollo 14. The basalt and all but one breccias contained 20 to 25 ppm nitrogen. One breccia (14049) and the fines had 70 to 80 ppm nitrogen. Nitrogen distribution in the latter two samples among different grain sizes shows that most of their nitrogen is surface correlated and is therefore likely to have come from solar-wind implantation. Some leaching experiments have been performed, demonstrating surface residence of excess nitrogen in fines. The solar wind C:N ratio is found to be 10:6 and is in good agreement with estimates based on spectroscopic data. The data generally give lower nitrogen contents than reported earlier. Classical methods apparently introduce a contamination of 20 to 50 ppm nitrogen. (auth)

11543 CHEMICALLY BOUND NITROGEN ABUNDANCES IN LUNAR SAMPLES, AND ACTIVE GASES RELEASED BY HEATING AT LOWER TEMPERATURES (250 TO 500°C). Mueller, O. (Max Planck-Institut fuer Kernphysik, Heidelberg). Geochim. Cosmochim. Acta; Suppl. 3: 2059-2068(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972).

See CONF-720121-(Vol.2).

Chemically bound nitrogen concentrations have been determined in lunar samples from different Apollo landing sites using the Kjeldahl method. This technique discriminates against molecular nitrogen, N_2, which may be a possible cause for contamination of lunar material by terrestrial atmospheric nitrogen. The results show that the main amount of nitrogen is present in a bound state. Nitrogen analyses on grain size fractions of Apollo 14 and Apollo 15 fines have revealed that nitrogen is clearly correlated with the grain surfaces and derives most likely from the solar wind. Nitrogen can be used as a reference element in terms of solar elemental abundances because it is chemically active and, therefore, is better retained on grain surfaces than the lighter solar-wind noble gases. The predominant gases released from fines 14003 and 15101 and fragmental rock 14303 by heating between 250 and 500°C are H_2, CO, CO_2, and CH_4. Minor amounts of C_2H_6, C_3H_8, C_2H_4 (C_2H_2), and C_3H_6 were detected only at the higher temperatures. No molecular nitrogen was detected during the heating experiments; this is probably due to the high portion of chemically bound nitrogen. Crushing experiments have been performed on some vesicular lunar rock and glass samples to study trapped gases. Only traces of methane have been detected, and no other active gases have been found. (auth)

11544 SURVEY OF LUNAR CARBON COMPOUNDS. II. The Carbon Chemistry of Apollo 11, 12, 14, and 15 Samples. Cadogan, P. H.; Eglinton, G.; Firth, J. N. M.; Maxwell, J. R.; Mays, B. J.; Pillinger, C. T. (Univ. of Bristol, Eng.). Geochim. Cosmochim. Acta; Suppl. 3: 2069-2090(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

The methane and carbide concentrations of a number of Apollo 11, 12, 14, and 15 samples of fines and breccias were examined by the deuterated acid dissolution method. Location studies indicate that these carbon compounds are concentrated in the outer surfaces of the fines particles of 48-152 μ diameter; for larger particles a volume-related component may contribute. In individual samples the methane and carbide concentrations correlate with parameters indicative of lunar surface exposure. The data provide further evidence that solar wind implantation is the major source of the methane in the fines and that the carbide originates from both solar wind implantation and meteorite impacts. The carbon chemistry can be used as an exposure and reworking parameter and provides evidence for mixing in the Apollo 14 fines. The CH_4 and carbide concentrations in the Apollo 12 double core show the complex nature of the regolith at the Apollo 12 site. The metamorphic history of the Apollo 14 breccias is reflected in their carbon chemistry. (auth)

11545 COMPOUNDS OF CARBON AND OTHER VOLATILE ELEMENTS IN APOLLO 14 AND 15 SAMPLES. Holland, P. T.; Simoneit, B. R.; Wszolek, P. C.; Burlingame, A. L. (Univ. of California, Berkeley). Geochim. Cosmochim. Acta; Suppl. 3: 2131-2147(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.2).

Several aspects of the carbon chemistry of a variety of Apollo 14 and 15 samples were investigated by DF dissolution and pyrolysis. The yields of indigenous methane and ethane for the suite of samples correlated with the amounts of solar-wind gases (^{20}Ne and ^{36}Ar) and the deuterocarbon reaction products. The lunar fines and F1 breccias examined yielded relatively higher amounts of CH_4 and CD_4 than more complex breccias and fragmental rocks. The yields of higher-weight deuterocarbons were significant for some samples. Pyrolysis of the samples examined evolved mainly CO and N_2 with some CO_2. The CO and N_2 exhibited a similar bimodal evolution pattern. Terrestrial contaminants (H_2O, hydrocarbons, and some CO_2) were volatilized at lower temperatures. In the intermediate temperature ranges some apparent pyrolytic reaction products were released. The bulk of the nonlabile carbon was released at higher temperatures to sample fusion. Other compounds observed and quantitated by these techniques were DCN, HCN, CS_2, D_2S, and PD_3. The source of a major portion of the C and N appears to be solar wind and meteoritic input. (auth)

11546 APOLLO 15 X-RAY FLUORESCENCE EXPERIMENT. Adler, I. (Goddard Space Flight Center, New York); Gerard, J.; Trombka, J.; Schmadebeck, R.; Lowman, P.; Blodget, H.; Yin, L.; Eller, E.; Lamothe, R.; Gorenstein, P.; Bjorkolm, P.; Harris, B.; Gursky, H. Geochim. Cosmochim. Acta; Suppl. 3: 2157-2178 (1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.3).

The prime purpose of the x-ray fluorescence spectrometer carried in the Scientific Instrument Module (SIM) of the Command-Service Module (CSM) was to map the lunar surface with respect to its chemical composition. Results are presented for Al, Mg, and Si as Al/Si and Mg/Si ratios for the various features overflow by the spacecraft. The lunar surface measurements involved observations of the intensity and characteristic energy distribution of the secondary or fluorescent x rays produced by the interaction of solar x rays with the lunar surface. The results showed that the highlands and maria are chemically different, with the highlands having considerably more Al and less Mg than the maria. The mare-highland contact is quite sharp and puts a limit on the amount of horizontal transport of material. The x-ray data suggests that the dominant rock type of the lunar highlands is a plagioclase-rich pyroxene bearing rock probably anorthositic gabbro or feldspathic basalt. Thus the Moon appears to have a widespread differentiated crust (the highlands) systematically richer in Al and lower in Mg than the maria. This crust is pre-mare and may represent the first major internal differentiation of the Moon. (auth)

11547 OBSERVATION OF LUNAR RADON EMANATION WITH THE APOLLO 15 ALPHA PARTICLE SPECTROMETER. Gorenstein, P.; Bjorkholm, P. (American Science and Engineering, Cambridge, MA). Geochim. Cosmochim. Acta; Suppl. 3: 2179-2187(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.3).

The alpha particle spectrometer, a component of the orbital Sim Bay group of "geochemistry" experiments on Apollo 15, was designed to detect alpha particles emitted during the decay of isotopes of radon gas and her daughter products. The purpose was to measure the gross activity of radon on the lunar surface and to find possible regions of increased local activity. Results are presented from a partial analysis of Apollo 15 data. For the Moon as a whole, ^{220}Rn was not observed and the upper limit on its decay rate above the lunar surface is 3.8×10^{-4} disintegrations/cm^2-sec. ^{222}Rn was marginally observed, but until further analysis can be carried out, the result is reported as an upper limit of 10^{-3} disintegrations/cm^2-sec. Possible variations of radon activity on the lunar surface are being investigated. ^{210}Po (a daughter product of ^{222}Rn) was detected in a broad region from west of Mare Crisium to the Van de Graaff-Orlov region. The observed count rate was $(4.6 \pm 1.4) \times 10^{-3}$ disintegrations/cm^2-sec. The observed level of ^{210}Po activity was in excess of the amount that would be in equilibrium with ^{222}Rn by about an order of magnitude. This implies that larger levels of radon emanation have occurred on the Moon within a time scale of 10^1 to 10^2 years. (auth)

11548 MICROPHYSICAL, MICROCHEMICAL, AND ADHESIVE PROPERTIES OF LUNAR MATERIAL. III. Gas Interaction with Lunar Material. Grossman, J. J.; Mukherjee, N. R.; Ryan, J. A. (McDonnell Douglas Astronautics Co., West Huntington Beach, CA). Geochim. Cosmochim. Acta; Suppl. 3: 2259-2269(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.3).

Gas adsorption measurements on an Apollo 12 ultrahigh vacuum-stored sample and Apollo 14 and 15 N_2-stored samples, show that the cosmic-ray track and solar-wind damaged surface of lunar soil is very reactive. Room temperature monolayer adsorption of N_2 by the Apollo 12 sample at 10^{-4} atm was observed. Gas evolution of Apollo 14 lunar soil at liquid nitrogen temperature during adsorption/desorption cycling is probably due to cosmic-ray track stored energy release accompanied by solar gas release from depths of 100 to 200 nm. (auth)

11549 MAGNETIC FIELDS NEAR THE MOON. Coleman, P. J. Jr. (Univ. of California, Los Angeles); Lichtenstein, B. R.; Russell, C. T.; Sharp, L. R.; Schubert, G. Geochim. Cosmochim. Acta; Suppl. 3: 2271-2286(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.3).

Magnetic-field measurements made with the Apollo 15 subsatellite have established the existence of remanent magnetization over much of the Moon's surface. The major features of the structure of the measured remanent field are apparently associated with large craters, the most apparent detected to date being that associated with the Van de Graaff crater. A preliminary contour map of relative magnetic intensity has been produced for a limited region of the Moon. Magnetic-field measurements taken while the Moon was in the solar wind have revealed the frequent presence of regions just downstream from the limbs characterized by substantially increased field strengths. Similar temporary regions have been detected previously at greater distances with the lunar satellite Explorer 35. They have been attributed to limb shocks produced by the grazing interaction of the solar wind with regions of locally high remanent magnetization at the limbs. Studies of the occurrence of these shock effects at the subsatellite orbit indicate that one of the regions of the lunar surface that is apparently highly effective in producing limb shocks is also a region of relatively strong remanent fields, thus supporting this explanation as to the general cause of the limb shocks. (auth)

11550 SURFACE MAGNETOMETER EXPERIMENTS: INTERNAL LUNAR PROPERTIES AND LUNAR FIELD INTERACTIONS WITH THE SOLAR PLASMA. Dyal, P.; Parkin, C. W.; Cassen, P. (Ames Research Center, Moffett Fields, CA). Geochim. Cosmochim. Acta; Suppl. 3: 2287-2307(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972).

See CONF-720121-(Vol.3).

The remanent magnetic fields measured to date on the Moon are $38 \pm 3\ \gamma$ at Apollo 12 in Oceanus Procellarum; 103 ± 5 and $43 \pm 6\ \gamma$ at two Apollo 14 sites separated by 1.1 km in Fra Mauro; and $6 \pm 4\ \gamma$ at the Apollo 15 Hadley-Apennines site. Measurements show that the 38-γ remanent field at Apollo 12 is compressed to 54 γ by a solar-wind pressure increase of 7×10^{-8} dyne/cm^2. The change in magnetic pressure is proportional to the change in plasma pressure and the field is compressed primarily in the z (northerly) component. The whole-Moon relative magnetic permeability has been calculated to be $\mu/\mu_0 = 1.01 \pm 0.06$ from measurements taken while the Moon was immersed (magnetized) in the geomagnetic tail. The electrical conductivity of the lunar interior has been determined from magnetic step transient measurements made on the lunar dark side. A range of monotonic conductivity profiles is calculated that provides a fit to the normalized data curve within error limits. Deeper than 90 km into the Moon, the conductivity rises from 3×10^{-4} mhos/m to 10^{-2} mhos/m at 1000 km depth. These conductivities, when converted to temperatures for an assumed lunar material of peridotite, suggest the existence of a thin outer layer (perhaps 90 km thick) in which the temperature rises sharply to 850 to 1050°K, then increases gradually to 1200 to 1500°K at a depth of about 1000 km. (auth)

11551 INDUCED MAGNETIC FIELD OF THE MOON: CONDUCTIVITY PROFILES AND INFERRED TEMPERATURE. Sonnett, C. P. (Ames Research Center, Moffett Field, CA); Smith, B. F.; Colburn, D. S.; Schubert, G.; Schwartz, K. Geochim. Cosmochim. Acta; Suppl. 3: 2309-2336(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.3).

Electromagnetic induction in the Moon driven by fluctuations of the interplanetary magnetic field is used to determine the lunar bulk electrical conductivity. The earlier data are now augmented by an order of magnitude. The present data clearly show the North-South and East-West transfer function difference as well as the high-frequency rollover suggested earlier. The difference is shown to be compatible over the midfrequency range (10^{-3} to 10^{-2} Hz) with a noise source associated with the compression of the local remanent field by solar-wind dynamic pressure fluctuations. (WDM)

11552 DIRECT OBSERVATION OF THE LUNAR PHOTOELECTRON LAYER. Reasoner, D. L.; Burke, W. J. (Rice Univ., Houston, TX). Geochim. Cosmochim. Acta; Suppl. 3: 2639-2654 (1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972).

See CONF-720121-(Vol.3).

The Charged-Particle Lunar Environment Experiment (CPLEE), a part of the Apollo 14 ALSEP, is an ion-electron spectrometer capable of measuring ions and electrons with energies between 40 eV and 50 keV. Accordingly, the instrument, with apertures 26 cm above the surface, has detected a layer of photoelectrons, or photoelectron gas above the sunlit lunar surface with energies ranging up to 200 eV. The experimental data for periods when the Moon was in the Earth's magnetotail for electron energies between 40 and 200 eV follows a power-law spectrum of the form $j(E) = j_0(E/E_0)^{-\mu}$, with $j_0 = 2.5 \times 10^5$ electrons/cm^2-sec, $E_0 = 40$ eV, and $\mu = 3.5$. The implications of this measurement are two-fold in that the lunar surface potential can be immediately determined to be at least 200 V, and a value of the photoelectron yield of the lunar surface material for photon energies above 40 eV may be computed. (WDM)

11553 PHOTOEMISSION FROM LUNAR SURFACE FINES AND THE LUNAR PHOTOELECTRON SHEATH. Feuerbacher, B.; Anderegg, M.; Fitton, B.; Laude, L. D.; Willis, R. F.; Grard, R. J. L. (European Space Research Organization, Noordwijk, Netherlands). Geochim. Cosmochim. Acta; Suppl. 3: 2655-2663 (1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.3).

Measurements are reported on the photoelectric properties of lunar surface fines. The experimental results are used to calculate the photoelectric saturation current and its energy distribution under solar irradiation. A Maxwellian approximation for the energy distribution permitted a preliminary calculation of the photoelectron sheath properties in terms of electron density and electric field as a function of distance above the lunar surface. The sheath was found to be very tenuous: The surface electron density was 130 electrons/cm^3 and the surface shielding distance was 78 cm. (auth)

11554 SECONDARY ELECTRON EMISSION CHARACTERISTICS OF LUNAR SURFACE FINES. Anderegg, M.; Feuerbacher, B.; Fitton, B.; Laude, L. D.; Willis, R. F. (European Space Research Organization, Noordwijk, Netherlands). Geochim. Cosmochim. Acta; Suppl. 3: 2665-2669(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.3).

The secondary electron yield and energy distribution of a lunar dust sample are reported over an incident electron energy range of 50 to 2000 eV. Preliminary results are discussed in terms of their pertinence to calculations of the electrostatic potential and charge distribution of the lunar surface. (auth)

11555 SIMULATED MICROSCALE EROSION ON THE LUNAR SURFACE BY HYPERVELOCITY IMPACT, SOLAR WIND SPUTTERING, AND THERMAL CYCLING. McDonnell, J. A. M.; Ashworth, D. G.; Flavill, R. P.; Jennison, R. C. (Univ. of Kent, Canterbury, Eng.). Geochim. Cosmochim. Acta; Suppl. 3: 2755-2765(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.3).

Initial results from an experimental program investigating simulated erosion on a microscale by hypervelocity impact of iron spheres, thermal cycling, and solar wind sputtering are presented. (WDM)

11556 LUNAR CRATERS AND EXPOSURE AGES DERIVED FROM CRATER STATISTICS AND SOLAR FLARE TRACKS. Neukum, G.; Schneider, E.; Mehl, A.; Storzer, D.; Wagner, G. A.; Fechtig, H.; Bloch, M. R. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Geochim. Cosmochim. Acta; Suppl. 3: 2793-2810 (1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.3).

Measurements of microcraters performed on Apollo 14 and 12 rocks are discussed. The investigations were performed optically and with the help of a scanning electron microscope. The identification of craters and conversion of crater data to particle properties is based on new simulation experiments. With the assumption that micron- and submicron-size craters are mainly eroded by solar wind sputtering, a cumulative micrometeoroid flux is calculated. For sample 12024,8 an exposure age of 2500 years was determined by solar-flare track methods in addition to the crater size frequency. From crater size frequency measurements of large craters with diameters >3 km the time development of the lunar surface can be studied. Using theoretical arguments of erosion of craters by impact superposition, mean formation ages of various parts of the lunar surface were calculated. (auth)

11557 COLLISION CONTROLLED RADIATION HISTORY OF THE LUNAR REGOLITH. Bhandari, N.; Goswami, J. N.; Gupta, S. K.; Lal, D.; Tamhane, A. S.; Venkatavaradan, V. S. (Tata Inst. of Fundamental Research, Bombay). Geochim. Cosmochim. Acta; Suppl. 3: 2811-2829(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.3).

Several rock and soil samples from Apollo 12 and 14 sites were studied for fossil records of cosmic-ray tracks ($Z > 20$). The exposure history of samples derived from these data was analyzed in terms of erosion, fragmentation, and burial. It is shown that the accumulation of tracks up to depths of a few centimeters in case of rocks is definitely controlled by collisional processes; at depths of < 0.1 cm, the track densities are found to be in equilibrium with production and erosion. The effective time of irradiation of samples at the lunar surface varies between 10^3 to 10^7 yr. The mean total erosion rates applicable to near surface (< 0.1 cm) regions of rocks are deduced to lie between 5×10^{-6} and 10^{-7} cm yr^{-1}. Data on fossil tracks in a through slice of rock 14303 lead to an energy spectrum of iron group cosmic ray nuclei which is consistent with that derived earlier from two Apollo 12 rocks deduced to have simple exposure histories. Several other breccias show a complicated exposure history making it difficult to derive the primary composition or the energy spectrum of iron group nuclei. None except rock 14301, however, show any signs of pre-irradiation histories of individual fragments comprising the breccia. Adjacent feldspars from the interior of 14301 had track densities ranging between $(3-80) \times 10^6$ cm^{-2}. The soil samples show a range of track densities similar to that found for Apollo 11 and 12 samples. These data confirm the general validity of the irradiation and the "throw-out" model presented earlier. Based on burial depths of documented Apollo 14 rocks, it is deduced that most rocks on surface today represent fragments of larger rocks and that the average deposition rate of regolith at the Apollo 14 site is in the region of (0.15 to 0.3) cm m.y.$^{-1}$. (auth)

11558 GRAIN SIZE ANALYSIS, OPTICAL REFLECTIVITY MEASUREMENTS, AND DETERMINATION OF HIGH-FREQUENCY ELECTRICAL PROPERTIES FOR APOLLO 14 LUNAR SAMPLES. Gold, T.; Bilson, E.; Yerbury, M. (Cornell Univ., Ithaca, NY). Geochim. Cosmochim. Acta; Suppl. 3: 3187-3193(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol.3).

The particle size distribution was measured for the Apollo 14 bulk and contingency fines as well as for two subsamples from the 14230 core sample. Among these samples there seemed to be no significant variation in grain size distribution. Reflectivity measurements on lunar fines from different Apollo missions showed that their albedo decreased significantly after being subjected to a dose of proton bombardment which would be equivalent to approximately 1.5×10^4 years of solar wind. Results of dielectric constant and power absorption length measurements are reported for Apollo 14 fines and an Apollo 14 rock sample. A strikingly long absorption length 28 wavelengths was observed for the rock sample 14310,161 at 450 MHz. (auth)

11559 PROCEEDINGS OF THE THIRD LUNAR SCIENCE CONFERENCE. Volume 3. Conference held at Houston, Texas, January 10-13, 1972. Criswell, D. R. (ed.). Geochimica et Cosmochimica Acta, Supplement 3. Cambridge, MA; Massachusetts Institute of Technology (1972). 924p. (CONF-720121-(Vol. 3)). $32.00.

From 3rd lunar science conference; Houston, Texas, USA (10 Jan 1972).

Separate abstracts were prepared for twenty-seven of the papers. (WDM)

For abstracts of individual papers see: 11390-11403, and 11546-11558.

11560 THERMAL REGIME OF THE EARTH'S CORE. Verhoogen, J. (Univ. of California, Berkeley). Phys. Earth Planet. Interiors; 7: No. 1, 47-58(Apr 1973).

The outer core is assumed to consist of iron and sulfur, with a small amount of potassium that generates heat by radioactive decay of ^{40}K. Two cases are considered, corresponding respectively to a high rate of heat production, and to a low rate (Q). The temperature at a depth of 2800 km in the mantle is taken to be 3300°K. The temperature T_c at the core-mantle boundary depends on whether or not a density gradient in the lowermost layer D'' of the mantle prevents convection in that layer. In the first case, and for high Q, T_c = 4500 to 5000°K. In the second case, or for low Q, $T_c \approx 3500$°K. (WDM)

11561 INTENSITY OF JUPITER'S ATMOSPHERIC BELTS AND SOLAR ACTIVITY. Pokorny, Z. (Observatory, Prostejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 2, 109-110(1973).

Using Chree's superposition method the relationship between Jupiter's photometric coefficient of activity R, which gives the intensity of the atmospheric belts of the planet, and solar activity was investigated. An analysis of the R-values from the interval 1904-1968 yielded a two-maximum relationship over the 11-year cycle, which indicated that the intensity of the belts in Jupiter's atmosphere is probably affected by the occurrence of solar proton and similar events, connected with the emission of particles into interplanetary space. (auth)

11562 ALTERATION OF AN APOLLO 12 SAMPLE BY ADSORPTION OF WATER VAPOR. Holmes, H. F. (Oak Ridge National Lab., TN); Fuller, E. L. Jr.; Gammage, R. B. Earth and Planetary Science Letters; 19: No. 1, 90-96(May 1973).

The adsorption of water vapor caused radical changes in the surface characteristics of an Apollo 12 lunar fines sample. In the initial state, the sample had a relatively low specific surface area and no inherent porosity as deduced from the adsorption isotherms of nitrogen and argon. However, the sample interacted strongly with water vapor, particularly at high relative pressures, and irreversibly retained, in vacuum, a quantity of water much larger than can be explained by a simple chemisorption process. The interaction with water vapor more than doubled the specific surface area and created a pore system. The suggested explanation is that water penetrates the severely radiation damaged, amorphous

surface layers of the particles and creates pores by leaching out channels or forcing apart adherent particles. Lunar fines from the Apollo 11, 12, and 14 missions have markedly different reactivities toward water vapor, an observation which remains unexplained at the present time. (auth)

11563 NEW SEISMIC DATA ON THE STATE OF THE DEEP LUNAR INTERIOR. Nakamura, Y. (Univ. of Texas Medical Branch, Galveston); Lammelein, D.; Latham, G.; Ewing, M.; Dorman, J.; Press, F.; Toksoez, N. Earth and Planetary Science Letters; 19: No. 1, 49-51(May 1973).

Direct shear-wave arrivals from seismic events originating on the far side of the Moon are not observed at some of the stations of the Apollo seismic network. These data suggest that the material in the lunar interior at a depth of 1000 to 1100 kilometers is more dissipative for seismic shear waves than the lithosphere above, and possibly exists in a partially molten state akin to the Earth's asthenosphere. (auth)

11564 CERTAIN PARTICULAR SOLUTIONS OF THE CLAIRAUT EQUATION. Lanzano, P. (Naval Research Lab., Washington, DC). Astrophys. Space Sci.; 20: No. 1, 71-83(Jan 1973).

A study was conducted to ascertain conditions on the density distribution within a fluid, rotating planet in order that the deformation of its outer shell be expressible in terms of the Bessel functions of the first kind and the Gaussian hypergeometric series. It was established that (1) the density must be a solution to an ordinary differential equation of the Riccati type, and (2) two already considered density distributions are the only closed-form solutions of physical relevance. (auth)

11565 WAVE PROPAGATION IN THE MAGNETOSPHERE OF JUPITER. Liemohn, H. B. (Boeing Aerospace Group, Seattle). Astrophys. Space Sci.; 20: No. 2, 417-429(Feb 1973).

The magnetosphere of Jupiter has been the subject of extensive research in recent years due to its detectable radio emissions. Observations in the decimetric radio band have been particularly helpful in ascertaining the general shape of the Jovian magnetic field, which is currently believed to be a dipole with minor perturbations. Although there is no direct evidence for thermal plasma in the magnetosphere of Jupiter, theoretical considerations about the physical processes that must occur in the ionosphere and magnetosphere surrounding Jupiter have lead to estimates of the thermal plasma distribution. These models of the Jovian magnetic field and thermal plasma distribution, specify the characteristic plasma and cyclotron frequencies in the magnetosplasma and thereby provide a basis for estimating the local electromagnetic and hydromagnetic noise around Jupiter. Spatial analogs of the well-known Clemmow-Mullaly-Allis (CMA) diagrams have been constructed to identify the loci of electron and ion resonances and cutoffs for the different field and plasma models. Regions of reflection, mode coupling, and probable amplification are readily identified. The corresponding radio noise properties may be estimated qualitatively on the basis of these various electromagnetic and hydromagnetic wave mode regions. Frequency bands and regions of intense natural noise may be estimated. On the basis of the models considered, the radio noise properties around Jupiter are quite different from those encountered in the magnetosphere around the Earth. Wave particle interactions are largely confined to the immediate vicinity of the zenographic equatorial plane and guided propagation from one hemisphere to the other apparently does not occur, except for hydromagnetic modes of propagation. The characteristics of these local signals are indicative of the physical processes occurring in the Jovian magnetosphere. Thus, as a remote sensing tool, their observation will be a vital asset in the exploration of Jupiter. (auth)

11566 LIMITS TO JUPITER'S MAGNETOSPHERIC DIFFUSION RATES. Mihalov, J. A. (Ames Research Center, Moffett Field, CA). Astrophys. Space Sci.; 20: No. 2, 483-490(Feb 1973).

X-ray fluxes at Earth estimated from hypothetical fluxes and spectra of energetic particles trapped in Jupiter's magnetic field are found to be 1/170000 times the upper limit x-ray flux from Jupiter based on published results from a rocket experiment. Detection of the calculated x-ray flux from Jupiter does not necessarily provide information on an energetic trapped proton component because the x-ray flux due to the hypothetical trapped energetic proton fluxes alone is comparable in magnitude to that due alone to trapped energetic electron fluxes at Jupiter. (auth)

11567 PROCEEDINGS OF THE THIRD LUNAR SCIENCE CONFERENCE. Volume 1. Mineralogy and Petrology. Conference Held at Houston, Texas, January 10-13, 1972. King, E. A. Jr. (ed.). Geochimica et Cosmochimica Acta, Supplement 3. Cambridge, MA; Massachusetts Institute of Technology Press (1972). 1199p. (CONF-720121-(Vol. 1)). $32.00.

From third lunar science conference; Houston, Texas, USA (10 Jan 1972).

Separate abstracts were prepared for two of the papers. (WDM)

For abstracts of individual papers see: 11568 and 11569.

11568 URANIUM AND POTASSIUM FRACTIONATION IN PRE-IMBRIAN LUNAR CRUSTAL ROCKS. Lovering, J. F.; Wark, D. A.; Gleadow, A. J. W.; Sewell, D. K. B. (Univ. of Melbourne, Parkville, Australia). Geochim. Cosmochim. Acta; Suppl. 3: 282-294(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 1).

Uranium and potassium abundance data from rock clasts in recrystallized Apollo 14 breccia 14305 indicate that three uranium-potassium fractionation groups can be recognized: Group 1 Low U (<0.5 ppM)-low K (<0.3%), composed of mare-type basalts (subgroup A) and anorthosites (subgroup B). Group 2 Medium U (~1.6 to 4.8 ppM)-medium K (~0.4 to 2.3%), composed of nonmare type basalts and "norites." Group 3 High U (~5 to 12 ppM-high K (~3.9 to 6.2%), composed of "monzonitic" rocks (subgroup A) and glasses (subgroup B) probably derived from 3A rocks. This rock association is suggested to be typical of the near-surface crust of the Moon in pre-Imbrian times (i.e., $> 3.9 \times 10^9$ years ago) and shows marked similarities to rock associations characteristic of Precambrian massif-type anorthosite terrains on Earth. (auth)

11569 CHEMISTRY AND PARTICLE TRACK STUDIES OF APOLLO 14 GLASSES. Glass, B. P. (Univ. of Delaware, Newark); Storzer, D.; Wagner, G. A. Geochim. Cosmochim. Acta; Suppl. 3: 927-937(1972).

From third lunar science conference; Houston, Texas, USA (10 Jan 1972). See CONF-720121-(Vol. 1).

Apollo 14 glasses from the <1 mm fines can be divided into five major groups based on their major element composition. Of the 282 glass particles analyzed, most (group 4) have compositions similar to the Apollo 14 soils and breccias. These glasses are similar in composition to the KREEP glasses found in Apollo 12 fines. Feldspathic glasses (group 2) with high Al_2O_3 (>21%) and CaO (>15%) contents make up about 20% of the glass particles analyzed. This is the only glass type that has been found at all of the lunar landing sites, and it was probably derived from the highlands. Glasses with high FeO (>14%) and low Al_2O_3 (<15%) contents make up to 17 to 30% of the analyzed glasses. These glasses are probably derived from maria regions. Glasses with low Na_2O and K_2O (<0.4%) contents (group 5) may have been affected by vapor fractionation. A small number (<5%) of the glasses have anorthite compositions. Track analyses of twelve of the glass particles were carried out in order to determine their uranium contents and radiation histories. The uranium contents were found to range between 0.2 and 17 ppM with uranium correlating with K_2O content. Assuming a mean burial depth of 5 cm, radiation ages between 10^5 and 10^7 years were found. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 11450.

11570 (AD-737788) AIRBORNE PHOTOGRAPHIC MEASUREMENTS OF NATURAL AURORA, 1970-1971. Deuel, R. W.; Boquist, W. P. (Technology International Corp., Bedford, Mass. (USA)). Jul 1971. Contract F19628-70-C-0277. 18p. (TIC-724; AFCRL-71-480). NTIS.

Photographic measurements of faint auroral phenomena were made from AFCRL KC-135 No. 53120 during the fall-winter of 1970-71. As a partial objective of the project, instrumentation was developed to provide wide field of view (30 degrees-45 degrees) coverage with less than f/1 objective optics on a 70 mm film format. Extensive color and black and white records were obtained for AFCRL by using this instrumentation during the February-March auroral flight missions, which showed the detailed morphological development of highly striated aurora. (auth)

11571 (AD-738695) HF RADAR MEASUREMENTS OF PEAK ELECTRON DENSITY DURING TESTS CANUTO AND DARDABASI OF OPERATION BARBIZON. Final Technical Report. Thome, G. D.; Blood, D. W. (Raytheon Co., Sudbury, Mass. (USA)). Jan 1972. 27p. (RADC-TR-72-23). NTIS.

Tests Canuto and Dardabasi of Operation BARBIZON tested two new payload chemistries for producing ionized clouds in the upper atmosphere. Two 16-kg releases were made during each test, a standard chemistry release on the up-leg and a new chemistry release at the same altitude on the down-leg. The new chemistries were developed for test Canuto by Thiolol and for test Dardabasi by Space Data. Raytheon provided hf radar measurements of the peak electron density on each cloud as a function of time. (auth)

11572 (AD-751335) POLAR CAP BIBLIOGRAPHY WITH ABSTRACTS. 3. Energy Inputs and Outputs for the Polar Cap Upper Atmosphere. Brenton, J. G. (Dikewood Corp., Albuquerque, N. Mex.). 30 May 1972. Contract F19628-70-C-0212. 171p. (DC-TR-1212-4; AFCRL-72-459). NTIS.

The report contains abstracts on selected topics in the literature on upper atmospheric phenomena in the inner regions of the polar caps. Although a few references on cosmic rays, auroras, airglow, and noctilucent clouds go back to the 1930's or 1950's, the references are mostly from the last decade of 1961 through 1971. They are divided into 13 groups that cover the flux and energy spectrum of precipitated particles, cosmic rays, the optical emissions of aurora, airglow, and noctilucent clouds, atmospheric heating, photoionization, ionization by particle bombardment, and the instrumentation and measurement systems used to study the inputs and outputs of energy in the polar cap upper atmosphere. (auth)

11573 (AD-751336) POLAR CAP BIBLIOGRAPHY WITH ABSTRACTS. 4. The Structure and General Geophysical Characteristics of the Polar Cap Upper Atmosphere. Brenton, J. G. (Dikewood Corp., Albuquerque, N. Mex.). 15 Jun 1972. Contract F19628-70-C-0212. 78p. (DC-TR-1212-5; AFCRL-72-480). NTIS.

The references are generally to articles published between 1960 and the end of 1971. They are grouped under nine subject headings that describe the polar cap upper atmosphere and the instrumentation and measurement systems used in the studies. The subject headings are: temperatures, densities, winds, neutral composition, charged-particle composition, reaction mechanisms, reaction rates, general geophysical characteristics, and instrumentation and measurement systems for study of the polar cap atmosphere. (auth)

11574 (AD-751517) TOTAL ELECTRON MEASUREMENTS OF THE IONOSPHERE USING BEACON SATELLITES BEB (S66) AND BEC. Final Report, October 1964-July 1967. Koster, J. R.; Grimes, L. G. (Ghana Univ., Legon. Dept. of Physics). 1 Jun 1967. Contract AF61(052)-800. 114p. (AFCRL-72-562). NTIS.

The report describes the physical principles involved in measuring the total electron content (TEC) together with the equipment used. Details are also given of the main steps in the computer program used to calculate the TEC. The report deals with the TEC results measured simultaneously at two stations. This provides a means of testing the consistency of the results obtained using the first and second order theory. The report contains the tabulated results of the values of the TEC as measured at Legon. The results cover the period October 1964 to July 1967 and are given for both the first and second order theory. Various appendices give the source programs (in Fortran II) used in the calculations. (auth)

11575 (AD-751575) SOLAR X-RAY SPECTRUM DEFINITION AND THE PREDICTION OF IONOSPHERIC RADIO WAVE PROPAGATION. Research Report, May 1971-September 1972. Bleiweiss, M. P. (Naval Electronics Lab. Center, San Diego, Calif.). 1 Sep 1972. 52p. (NELC-TR-1840). NTIS.

The effects of deviations in determination of solar x-ray spectra on predictions of hf and vlf radio wave propagation parameters were determined for various levels of solar activity. For analytical purposes, the form that the uncertainties in the x-ray measurements assumed was that of uncertainties in the temperature of the solar emitting region as opposed to uncertainties in emission measure. The temperatures used to represent the various levels of solar activity were 5, 10, 15, and 20×10^6. The uncertainties in temperature T were represented by $T \pm \% \Delta XT$ where the percent changes were 0%, 10%, ±25%, ±50%. It is determined that for predictions of hf absorption, x-ray spectral definition is required to be better than ±25% for low temperatures and ±50% for high temperatures. vlf prediction requires the spectra to be known to at least 50% and probably ±25%. (NTIS)

11576 (AD-753162) RADIATION INDUCED F-REGION PLASMA PHENOMENA. Perkins, F. W.; Valeo, E. J. (Princeton Univ., N. J.). May 1972. Contract F30602-72-C-0053. 30p. (RADC-TR-72-263). NTIS.

Collective plasma phenomena induced in the ionospheric F region by intense high-frequency radiation are examined on several time and length scales. The short wavelength, high-frequency turbulence associated with the observed high-frequency enhanced electron density fluctuations at the electron plasma frequency is shown to result from parametric excitation of plasma and acoustic waves by the high-frequency radiation. The wave kinetic equation describing the nonlinear evaluation of the turbulence is presented. The time asymptotic spectral intensity is calculated and a formula for the total energy absorption from the incident radiation via nonlinear collective effects is obtained. A radiation induced self-focusing instability is found on a length scale somewhat larger than an ion Larmor radius, and is offered as a possible explanation for the occurrence of magnetic field aligned density filaments, which are associated with the phenomenon of "artificial spread-F." The calculated growth rates are in agreement with the time delay for appearance of spread-F after modifier turn on. (auth) (NTIS)

11577 (AD-753680) COMPILATION OF SCIENTIFIC RESULTS FROM THE SATELLITE OV1-15 (SPADES). Report for July 1968-1 December 1970. Rugge, H. R. (Aerospace Corp., El Segundo, Calif.). 15 Nov 1972. Contract F04701-72-C-0073. 241p. (SAMSO-TR-72-259). NTIS.

The compilation consists of all scientific papers published by Space Physics Laboratory scientists up to February 1972 that are based on data obtained wholly, or in part, from the OV1-15 satellite. In addition, a brief description of the OV1-15 satellite and a list of presentations on OV1-15 results are included. (auth)

11578 (AD-754250) STUDY OF POLAR CAP UPPER ATMOSPHERIC PHENOMENOLOGY. Final Report, 1 April 1970-30 September 1972. Brenton, J. G. (Dikewood Corp.; Albuquerque, N. Mex.). 27 Oct 1972. Contract F19628-70-C-0212. 38p. (DC-FR-1212; AFCRL-72-649). NTIS.

A study of polar cap upper atmospheric phenomenology was conducted to provide background information on the state of polar cap research and to investigate some global effects of polar cap disturbances. The results of a survey and evaluation of the literature on polar cap research, mainly from the International Geophysical Year through 1971, were documented in an extensive bibliography of titles with section summaries of the work referenced and in a four-volume bibliography with abstracts. Possible effects of polar cap disturbances were found in wave-like disturbances of the 5577 A emission intensity observed from the AFCRL Airglow Station at Sacramento Peak, New Mexico, on ten nights between December 1956 and June 1962. (auth)

11579 (AD-754436) COORDINATED MEASUREMENTS OF IONOSPHERIC IRREGULARITIES: DIGITAL PHOTOMETER DESIGN AND DEVELOPMENT. Sears, R. D. (Lockheed Missiles and Space Co., Palo Alto, Calif. Lockheed Palo Alto Research Lab.). 20 Oct 1972. Contract DASA01-71-C-0158. 33p. (LMSC/D-311213; DNA-2997-T). NTIS.

A photometer system has been designed which incorporates the concepts of modularity and fully digitized control and data recording electronics. Modularity allows field substitution of background subtraction techniques, filter choice, and choice of input optical configuration. Novel features include a trichroic filtering module which allows simultaneous monitoring of auroral or airglow emission intensities in three spectral regions with the same field of view and input optics. Also described is a novel three beam adaptation which allows monitoring of the emission intensity from three closely spaced regions in the upper atmosphere in the same spectral region. The digital counting and control electronics described are compatible with NIMBIN plug in modules and allow expansion of the system to many photon counting channels as well as ready interfacing with other data sources. (auth)

11580 (AD-755447) MODEL STUDIES OF THE LOWER IONOSPHERE. Rowe, J. N. (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). 14 Dec 1972. Contract N00014-67-A-0385-0014. 215p. (PSU-IRL-SCI-406). NTIS.

A summary of quiet D-region electron density measurements made by the wave interaction technique at The Pennsylvania State University for the period October 1969–January 1971 is presented. Some estimate of the uncertainty in these measurements is given also. The mean electron density profile for July 1970 noon and the measured relative positive ion composition are used as constraints to develop a model of D-region ion chemistry between 60 and 80 kilometers. The neutral densities were taken from previous experimental and theoretical studies. Electron production rates due to Lyman-alpha, ultraviolet, x rays, and galactic cosmic rays were considered. Some estimates are reported of the rate of conversion of NO^+ ions into water cluster ions, the NO density and the detachment rate. It is concluded that the model developed for summer noon conditions will predict reasonably well the average seasonal and diurnal behavior of the D-region electron density, in spite of uncertainties in the neutral chemistry. (auth) (NTIS)

11581 MEASUREMENT OF THE ION DENSITY IN THE EARTH'S IONOSPHERE AT ALTITUDES FROM 200 TO 6000 km. Babkov, O. I.; Bashkin, E. A.; Borisov, S. I.; Dubov, I. A.; Nikolaev, V. D.; Ul'yanov, E. G. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 5, 675-679(1972).

Translated from Kosm. Issled.; 10: No. 5, 746-750(1972).

The results of the ion density measurements performed by means of the artificial earth satellites (AES) Kosmos-379, Kosmos-398, and Kosmos-434 are discussed. The experimental method is described, and the possible errors are estimated. The altitude variation of the ion density is described. It is noted that the ion density at altitudes above 1500 km is stable. (auth)

11582 LATITUDINAL AND TIME VARIATIONS OF TOTAL ELECTRON NUMBER AND ITS GRADIENTS IN THE IONOSPHERE AT HIGH LATITUDES. Solodovnikov, G. K.; Migunov, V. M.; Yagovkin, A. R.; Ivanov, Yu. G. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 5, 725-728(1972).

Translated from Kosm. Issled.; 10: No. 5, 796-799(1972).

The results are given of observations of the phase difference of signals at two coherent frequencies in the USW range from the satellites Cosmos-356 and Cosmos-378 during a period of high solar activity. The observations were made at two points with latitudes differing by 12°; one of the points was situated in a region of auroral activity. (WDM)

11583 DERIVATION OF PHASE INFORMATION FROM FIELD STRENGTH OBSERVATIONS IN THE LONG-WAVELENGTH REGION FOR CONTROL OF THE HIGH ATMOSPHERE. Entzian, G. (Zentralinstitut fuer Solar-Terrestrische Physik, Kuehlungsborn, Ger.). Exp. Tech. Phys.; 20: No. 6, 513-519(1972). (In German).

At 1000 to 1500 km around lf transmitters the derivation of sky wave phase informations from the total field strength is possible. The sky wave phase is a function of the apparent reflection height which can be controlled continuously by simple field strength observations. By the examples of the diurnal variation, of ionospheric ionization effects by solar flares, and of the interdiurnal variability of the reflection height by variations of the quiet solar x-ray flux the sensitivity and usefulness of the indirect phase height measurement as method for control of the upper atmosphere is demonstrated. (auth)

11584 PENETRATION AND REFLECTION OF VLF WAVES THROUGH THE IONOSPHERE. Full Wave Calculations With Ground Effect. Tsuruda, K. (Tokyo Univ.). J. Atmos. Terrest. Phys.; 35: No. 7, 1377-1405(Jul 1973).

Numerical calculations of the full-wave treatment are made for vlf electromagnetic waves that are incident on to the plane-stratified ionosphere both from below and above. For both cases, special attention is paid to the variation of penetration and reflection coefficients with wave frequency, angle of incidence, magnetic dip angle, and various models of the ionospheric structure. The effect of conductive ground is taken into account in the calculation of the penetration and reflection coefficients of the waves incident from above. The modifications due to the presence of ground reflection are (1) both penetration and reflection coefficients vary considerably with angle of incidence as a result of the interference between the upward and the downward propagating waves, (2) reflection coefficient in the nighttime ionosphere is large enough to account for common type of repeated whistler echo trains. A new reciprocity relation is established which is related to the reflection coefficients of the waves incident onto the ionosphere from above. (auth)

11585 BEHAVIOUR OF THE TOPSIDE IONOSPHERE DURING MAGNETICALLY DISTURBED CONDITIONS. Gondhalekar, P. M. (Science Research Council, Slough, Eng.). J. Atmos. Terrest. Phys.; 35: No. 7, 1293-1298(Jul 1973).

Detailed studies of the storm-time behavior of the plasma frequency at the F2-layer peak and at 1000 km have been made using topside sounder satellite data recorded at middle and high northern latitudes within the longitude sector from 30°W to 180°W during summer and winter months in 1963. It is shown that (a) the storm-time behavior at 1000 km is quite different from that at the layer peak, (b) the effects which occur in summer are completely different from those in winter, (c) the daytime storm behavior is opposite to that observed at night, and (d) the effects of storms at latitudes where the magnetic dip is greater than 70° are significantly different from those at lower latitudes. There appear to be no major aspects of the storm-time behavior about which it is possible to generalize. (auth)

11586 LATITUDINAL VARIATION OF THE ELECTRON CONCENTRATION IN THE TOPSIDE IONOSPHERE IN WINTER. Gondhalekar, P. M.; King, J. W. (Science Research Council, Slough, Eng.). J. Atmos. Terrest. Phys.; 35: No. 7, 1299-1308 (Jul 1973).

Data obtained in the American sector by means of Alouette I during the winter of 1963–1964 are used to investigate the latitudinal variation of the electron concentration at the F2-layer peak and at 1000 km. By day, the values of f_0F2 appear to depend on geographic latitude rather than on magnetic dip, but at night the Earth's magnetic field controls the latitudinal variation of critical frequency. The daytime f_0F2 values are enhanced at latitudes where the magnetic dip is 60°; this enhancement, which has been reported by previous authors, does not exist at 1000 km. The daytime high-latitude electron concentration values for 1000 km are extremely variable; particularly large values are observed during magnetically disturbed conditions. Ground-based ionosonde data have been used to show that the main high-latitude trough occurs at 57° invariant latitude in both the American and Asian sectors. (auth)

11587 PHOTOMETRIC INVESTIGATION OF THE 4278 A AND 5577 A EMISSIONS IN AURORA. Henriksen, K. (Auroral Observatory, Tromsoe, Norway). J. Atmos. Terrest. Phys.; 35: No. 7, 1341-1350(Jul 1973).

The excitation of the green line is found consistent with major contribution from energy transfer from $N_2(A^3\Sigma_u^+)$ molecules and dissociative recombination of O_2^+ ions. The green/blue intensity ratio of the auroral pulsation amplitudes is found to be of the same magnitudes as in bright aurora, and in these displays the intensity ratio is increasing with intensity. (auth)

11588 ATMOSPHERIC COMPOSITION CHANGES AND THE F2-LAYER SEASONAL ANOMALY. Ruester, R. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.); King, J. W. J. Atmos. Terrest. Phys.; 35: No. 7, 1317-1322(Jul 1973).

It is suggested that the F2-layer seasonal anomaly observed at middle latitudes at times of large solar activity can be explained by seasonal variations in atmospheric composition changes. The continuity equations for the ions have been solved together with the equations of motion for the ions, electrons, and neutral particles for summer and winter conditions and it is concluded that the atmospheric composition changes required to explain the seasonal behavior of f_0F2 are in good agreement with results obtained using rockets and the incoherent scatter technique. (auth)

Effects of Nuclear Detonations

11589 (LA-UR-73-708) COMPARISON OF LOCKHEED AND AFWL BASED ABSORPTION COEFFICIENTS FOR AIR. Cox, A. N.; Tabor, J. E. (Los Alamos Scientific Lab., N. Mex.). [nd]. 15p. (CONF-730442-3). Dep. NTIS $3.00.

An extensive compilation of air absorption and scattering coefficients based on an Air Force Weapons Laboratory tape containing molecular and atomic continuum (no lines) absorptions has been available since July 1972. The atomic lines, scattering and both absorption and scattering coefficients above the 30,000°K upper limit of the AFWL data as well as other necessary features, were

added to complete the tabulation. The data have been used extensively in fireball calculations at Los Alamos. Now a similar tabulation has been made based on molecular cross-section data directly from Lockheed. All atomic continuum and line absorption and scattering as well as the higher temperature data have been added similarly to the AFWL based tabulation. Comparisons between the two absorption and scattering coefficient compilations are presented. (auth)

11590 (LA-UR-73-721) LATE-TIME PHENOMENOLOGY PREDICTIONS WITH AN ALMOST-LAGRANGIAN CODE. Brackbill, J. U.; Sutherland, C. D.; Tierney, M. S. (Los Alamos Scientific Lab., N. Mex.). [nd]. 20p. (CONF-730442-2). Dep. NTIS $3.00.

An implicit, arbitrary Lagrangian–Eulerian technique recently developed at LASL has been extended to calculate the magnetohydrodynamic flow associated with a high-altitude nuclear explosion. The present two-dimensional version of the code utilizing this technique offers two advantages with respect to existing, usually explicit phenomenology codes: (1) the almost-Lagrangian feature minimizes numerical diffusion and permits calculations of flows with high magnetic Reynolds numbers; (2) the implicit formulation circumvents the Alfven problem and therefore makes possible the efficient calculation of low-speed flows without the need for artificial limits on mass density, or fluid and signal speeds. The treatment of boundary conditions and zoning for an almost-Lagrangian calculation is discussed, and the solution technique for chemical rate equations is described. (auth)

Magnetospheric Phenomena

11591 (AD–751043) NONLINEAR INTERACTION OF LONG, UNMODULATED WHISTLER-MODE SIGNALS AND GYRORESONANT. Newman, C. E. (Stanford Univ., Calif. Inst. for Plasma Research). 20 Oct 1971. Contract N00014-67-A-0112-0062. 25p. (SU-IPR–491). NTIS.

Equations are derived which govern modulation of a continuous wave whistler-mode transition by resonant particles in a region limited in spatial extent. It is found that nonlinear wave–particle interaction results in amplitude modulation but not phase modulation. An integral equation is found which gives the temporal behavior of the amplitude of the signal emerging from the region. (auth)

11592 (AD–751568) REVIEW OF THE MAGNETOSPHERIC WAVE–PARTICLE INTERACTION WORKSHOP, HELD AT STANFORD RESEARCH INSTITUTE, MENLO PARK, CALIFORNIA, ON 11–13 JULY 1972. Vesecky, J. F. (Stanford Research Inst., Menlo Park, Calif.). Oct 1972. Contract N00017-72-C-0402. 60p. (SRI–1840-SR). NTIS.

A workshop on magnetospheric wave–particle interaction sponsored by ARPA and ONR was held at Stanford Research Institute, Menlo Park, California on July 11–13, 1972. The general view of the workshop participants was that significant wave amplification at ulf and vlf frequencies can be artificially stimulated by injecting cold plasma outside the plasmapause in the magnetosphere, and that specific military applications for such wave amplification (communications) and its associated particle precipitation (nuclear weapons effects) are possible. The following subjects were discussed: (1) potential military applications, (2) physics of the wave-amplifying mechanism, (3) experimental observations and current theory of ulf and vlf wave–particle interaction, and (4) design of experiments to investigate wave–particle interaction phenomena. It was also the view of the workshop participants that further research should be carried out to design an optimum experimental investigation of cold-plasma-injection phenomena. A detailed list of the necessary research topics was prepared and is included in the report. (auth)

11593 (AD-753196) SIMULATION OF GYRORESONANT ELECTRON-WHISTLER INTERACTIONS IN THE OUTER RADIATION BELTS. Ossakow, S. L.; Ott, E.; Haber, I. (Naval Research Lab., Washington, D. C.). Nov 1972. 20p. (NRL-MR-2532). NTIS.

Results are presented on computer simulation of whistler turbulence and velocity space diffusion in a magnetospheric-type plasma. This is an extension of previous work, where, here, the authors have raised the ratio of plasma frequency to cyclotron frequency and lengthened the system size. This has been done in order to bring the parameters more into the physical regime corresponding to the outer radiation belts. (auth)

11594 (AD–753665) MORPHOLOGY OF IONOSPHERIC F-REGION STORMS AT MIDDLE AND LOW LATITUDES. McCullough, W. F. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering). Dec 1972. 143p. (GEP/PH–73-14). NTIS.

Thesis.

The dependence of the onset time of the F-region electron density disturbance upon the local time of the geomagnetic storm commencement and main phase onset was investigated. Hourly value of the fractional deviations of foF2 from monthly median values at a world-wide network of ionosonde stations were examined during 29 geomagnetic storms occurring between July 1957 and December 1964 with main phase onset time lags of more than 2 hours and K-indices at Fredericksburg of t or greater. The relationship between the relative equatorial electrojet strength and the time rate of change of foF2 above Huancayo was investigated during eight geomagnetic storms. The structural morphology of the equatorial anomaly during two geomagnetic storms was also investigated. (auth)

11595 (AD–753679) ACCESS OF SOLAR PROTONS TO THE EARTH'S POLAR CAPS. Report for July 1971–May 1972. Fennell, J. F. (Aerospace Corp., El Segundo, Calif.). 29 Dec 1972. Contract F04701-72-C-0073. 39p. (SAMSO-TR–72-305). NTIS.

Energetic solar proton observations (≳300 keV) in the interplanetary medium by Explorer 33 and Explorer 35 and over the polar caps by Injun 5 during the period September 1968–March 1970 have been examined in detail. The solar proton intensities observed over the polar regions were compared to the interplanetary intensities on an absolute basis. (auth)

11596 (AD-754771) MAGNETOSPHERIC ELECTRON DENSITY MEASUREMENTS FROM UPPER HYBRID RESONANCE NOISE OBSERVED BY IMP-6. Shaw, R. R.; Gurnett, D. A. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Dec. 1972. Contract N00014-68-A-0196-0003. 46p. NTIS.

Naturally occurring radio noise at frequencies greater than the electron plasma frequency and less than the upper hybrid resonance frequency has been observed at relatively low altitudes in the ionosphere by several rocket- and spacecraft-borne radio noise experiments. Since the index of refraction for the extraordinary mode of propagation near the upper hybrid resonance is greater than one, it is generally believed that this noise is produced by Cherenkov radiation from super-thermal electrons. The University of Iowa plasma waye experiment on the IMP-6 spacecraft has detected a similar noise band, believed to be associated with the upper hybrid resonance frequency at large radial distances in the magnetosphere. (auth) (NTIS)

11597 (AD-755484) LOCATING THE MAGNETOSPHERIC RING CURRENT. Thorne, R. M.; Kennel, C. F. (California Univ., Los Angeles. Plasma Physics Group). Mar 1971. Contract AT(04-3)-34. 12p. (R-88). NTIS.

It is pointed out that 10-100 keV protons, which dominate ring current energetics, have two preferred regions of cyclotron instability, and consequently loss, which serve as stable trapping boundaries for ring current protons. The pertinent electromagnetic ion cyclotron instability therefore limits the ring current location, and, using the empirical notion that within the stable region the energy density does not exceed the geomagnetic energy density, also the ring current energy density, and therefore, the main phase depression. (auth)

11598 (LA-UR-73-732) MAGNETOSPHERIC PLASMA FLOW AND THE NATURE OF THE MAGNETOSPHERIC BOUNDARY LAYER. Hones, E. W. Jr. (Los Alamos Scientific Lab., N. Mex.). [nd]. 28p. (CONF-730539-1). Dep. NTIS $3.50.

From 7th ESLAB symposium on correlated interplanetary and magnetospheric observations; Saulgau, F.R. Germany (22 May 1973).

Bulk flow of plasma in the outer magnetosphere has been studied using measurements of protons ($30\ eV < E_p < 30\ keV$) made with electrostatic analyzers on the Vela satellites in circular orbits at geocentric distance, $r \sim 18\ R_E$. The flow is detected, and its velocity is measured by the spin modulation it causes in the response of the analyzers on the rotating (64-second period) satellites. Very rapid flow of plasma in the magnetotail plasma sheet occurs during magnetospheric substorms. As the plasma sheet thins early in a substorm expansion phase, bulk flow in the antiearthward direction at several hundred kilometers per second is sometimes detected, possibly indicating the formation of a neutral line at $r < 18\ R_E$. The plasma that re-inflates the plasma sheet late in a substorm is observed to be flowing earthward at speeds as great as ~1000 km/sec, suggesting that the neutral line is reestablished at $r > 18\ R_E$ at that time. As the satellites pass from the magnetotail to the magnetosheath, they traverse a region, the boundary layer, whose thickness ranges up to a few thousand kilometers. The boundary layer plasma has a temperature similar to that of the magnetosheath plasma, but its number density and bulk flow speed are substantially less than those of the magnetosheath plasma. It is suggested that the boundary layer is the magnetic projection of the dayside cusp and is a site of energy and plasma transfer from the magnetosheath into the plasma sheet. (auth)

11599 (N-71-12774) PLASMA CLOUDS IN THE MAGNETOSPHERE. De Forest, S. E.; McIlwain, C. E. (California Univ., San Diego, La Jolla (USA). Space Physics Group). Sep 1970. 56p. NTIS.

Equatorial observations by the geostationary satellite ATS-5 of the charged particles on auroral lines of force reveal the frequent injection of plasma clouds into the magnetosphere. These intrusions of hot plasma are found to have a one-to-one correspondence with magnetospheric substorms. The clouds are dispersed by the earth's magnetic and electric fields in a fashion which generates complicated energy structure. (auth)

11600 (N-72-29277) ELECTROSTATIC INSTABILITY OF RING CURRENT PROTONS BEYOND THE PLASMAPAUSE DURING INJECTION EVENTS. Coroniti, F. V.; Fredricks, R. W.; White, R. (TRW Systems Group, Redondo Beach, Calif. (USA). Space Sciences Dept.). 1 May 1972. Contract NASw-2357. 12p. (NASA-CR-127756; TRW-22945-6001). NTIS.

The stability of ring current protons with an injection spectrum modeled by an m = 2 mirror distribution function was examined for typical ring current parameters. It was found that the high-frequency loss cone mode can be excited at wave numbers $K\lambda_{D_i} \simeq 0.1$ to 0.5, at frequencies $\Omega \simeq 0.2 + 0.6\,\Omega_{\tau}$ and with growth rates up to $\gamma/\Omega_{\tau} \simeq 0.03$. These waves interact with the main body of proton distribution, and propagate nearly perpendicular to the local magnetic field. Cold particle partial densities tend to reduce the growth rate so that the waves are quenched at or near the plasmapause boundary. Wave e-folding lengths are comparable to 0.1 R_e compared to the value of about 4 R_e found for ion cyclotron waves at the same plasma conditions. (auth)

11601 (N-73-15404) EXCITATION OF NATURAL OSCILLATIONS OF THE EARTH'S MAGNETIC TAIL. Ershkovich, A. I. Translated from Geomagn. Aeron.; 12: No. 5, 877-881(1972). 5p. NTIS.

The amplitude is estimated of the natural electromagnetic oscillations of the geomagnetic tail excited by solar-wind velocity changes. Based on the assumption that the tail is a plasma cylinder submerged in the interplanetary plasma, the dispersion equations for the oscillations were obtained. It is concluded that fluctuations in the solar-wind parameters should result in periodic oscillations of the angle of aberration of the Earth's magnetic tail. (STAR)

11602 LINEAR RELATIONSHIPS IN GEOMAGNETIC VARIATION STUDIES. Lilley, F. E. M.; Bennett, D. J. (Australian National Univ., Canberra). Phys. Earth Planet. Interiors; 7: No. 1, 9-14(Apr 1973).

The linear properties of Maxwell's equations enable the primary and secondary fields of geomagnetic variations to be related together by an induction tensor. Variations of total field which are confined on or near a plane, as described first by Parkinson, can occur formally only under certain conditions on either the induction tensor (that it have a simple degeneracy), or on the primary variation field components (that they consistently obey the same linear relationship over all time). The second condition is implausible for typical transient variations observed on Earth, and examination of the first condition demonstrates that for variations with no consistent correlation of the horizontal components, the existence of a well-determined Parkinson vector means that observed vertical variations are secondary fields, induced by observed horizontal variations. This conclusion has important implications for the theoretical explanation of the geomagnetic "coast effect." That primary fields be spatially uniform is a tacit condition of much theoretical work on geomagnetic variations, though the condition can in fact be relaxed to require spatial uniformity of the primary fields just within some "induction region." If however the primary fields are not uniform over the induction region a poor Parkinson-vector determination may result. This may be most noticeable at sites which have their induction regions greatly extended by a process such as current channelling. (auth)

11603 INFLUENCE OF THE INCLINATION OF THE GEOMAGNETIC LINES OF FORCE ON THE FIELD OF THE MAGNETOSPHERIC–IONOSPHERIC CURRENT SYSTEM. Abramov, L. A.; Debabov, A. S. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 5, 643-652(1972).

Translated from Kosm. Issled.; 10: No. 5, 711-720(1972).

The problem of the spreading of the oblique bifilar current in a thin, homogeneous plane ionosphere with a Hall conductivity and an anisotropy of the Pedersen conductivity is solved in the quasistatic approximation. The magnetic field is computed at the level of the Earth's surface; the field is important for a more precise determination of the structure of the SPP with an amplitude maximum at the mid-latitudes. (auth)

11604 ENERGY DENSITY OF EXCESS RADIATION AT MIDDLE LATITUDES. Tsaplin, V. S.; Shavrin, P. I.; Gribkov, V. M. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 5, 664-667(1972).

Translated from Kosm. Issled.; 10: No. 5, 732-736(1972).

On the basis of the results of measurements of the excess radiation spectrum at middle latitudes, the energy density of the excess radiation is calculated as $\epsilon \approx 0.12 \pm 0.01$ eV/cm^3. It is shown that this value amounts to less than one-quarter of the energy density of the primary cosmic radiation in the region of space being considered. The results obtained do not contradict the assumption about the secondary nature of the high-energy component of excess radiation in relation to the primary cosmic rays. A number of reasons are expressed concerning the specific nature of formation of the spectrum discussed. (auth)

11605 ESRO-IV SATELLITE. Lafay, J. F. (European Space Research and Technology Centre, Nordwijk, Netherlands). ELDO/ESRO Sci. Tech. Rev.; 4: No. 4, 313-351(1972). (In French).

ESRO-IV, the seventh satellite to be built by the European Space Research Organization, is scheduled for launch from the Western Test Range, California, in November 1972. It will carry five scientific experiments for investigation of neutral and ionized particle species and densities in the ionosphere and near magnetosphere, and the flux energy and pitch-angle distribution of auroral particles. The satellite will also be provided with a horizon-crossing indicator. The experiments and the satellite subsystems are described. Launch and orbital details are presented and the industrial and contractual aspects of the project are outlined. (FR)

11606 IONOSPHERIC ELECTRIC FIELD DURING SUBSTORMS: INTERPRETATION BASED ON NONUNIFORM RECONNECTION IN THE GEOMAGNETIC TAIL. Cowley, S. W. H. (Imperial Coll. of Science and Tech., London). Astrophys. Space Sci.; 20: No. 2, 491-497(Feb 1973).

It is suggested that changes in the electric field in the nightside auroral zone and polar cap observed during the expansion phase of a substorm are related to a change in the magnetospheric flow pattern. During the substorm growth phase the flow appears to be fairly uniform across the width of the magnetosphere (uniform electric field across the tail), while at expansion the observations are consistent with the magnetospheric potential drop in the tail falling across a narrow region near the dusk magnetopause. Such nonuniform electric fields in the tail have been predicted by recent theoretical work. A rather speculative interpretation of events during a magnetospheric substorm is presented. (auth)

11607 MAGNETOTAIL RESPONSE TO SUDDEN CHANGES IN THE INTERPLANETARY MAGNETIC FIELD. Nishida, A.; Nagayama, N. (Tokyo Univ.). Astrophys. Space Sci.; 20: No. 2, 459-472(Feb 1973).

The effect of southward or northward changes in the interplanetary magnetic field is examined statistically in the nightside magnetosphere over the range of 6.6 to 80 R_E. After southward changes, the deformation of the magnetosphere toward a greater anti-sunward extension of field lines occurs at 6.6 R_E with $\lesssim$10 min delay and spreads down the tail to 80 R_E in $\lesssim$30 min. Around the onset of the field-line collapse that occurs 1 to 2 hr later, the southward-directed field is observed briefly in the distant tail. The effect of northward changes could not be recognized in the lobe region of the tail. (auth)

11608 INTERPLANETARY MAGNETIC FIELD AND GEOMAGNETIC DST VARIATIONS. Patel, V. L. (Univ. of Denver); Desai, U. D. Astrophys. Space Sci.; 20: No. 2, 431-437(Feb 1973).

The interplanetary magnetic field is shown to influence the ring current field represented by Dst. Explorer 28 hourly magnetic field observations were used with the hourly Dst values. The moderate geomagnetic storms of 60 γ and quiet-time fluctuations of 10 to 30 γ were correlated with the North to South change of the interplanetary field component perpendicular to the ecliptic. This change in the interplanetary field occurs one to three hours earlier than the corresponding change in the Dst field. (auth)

11609 THREE DIMENSIONAL DYNAMO THEORY IN THE MAGNETOSPHERE. Pratap, R. (Physical Research Lab., Ahmedabad, India); Sarabhai, V.; Nair, K. N. Astrophys. Space Sci.; 20: No. 2, 307-327(Feb 1973).

The three-dimensional dynamo equation consistent with the conditions in the magnetosphere is solved. The conductivity adopted is that for a fully ionized but highly rarefied gas in a magnetic field. The velocity field is based on the measurements of the convection patterns made by different satellites. The solution obtained of the dynamo equation is presented in the most

general form so that it can be used when the various parameters are known to a higher degree of accuracy in future. A model calculation is made based on the particular solution of the inhomogeneous differential equation and the components of the current as well as the isointensity curves in the midday–midnight meridional plane as well as on the dawn-dusk meridional plane are computed. These theoretical results are matched with observations. (auth)

11610 SELF-CONSISTENT TWO-DIMENSIONAL APPROACH TO MAGNETOSPHERIC STRUCTURES. Soop, M. (European Space Operation Center, Darmstadt, Ger.); Schindler, K. Astrophys. Space Sci.; 20: No. 2, 287-305(Feb 1973).

A simple self-consistent description of the geomagnetic tail is given and its consequences are explored. The model is two-dimensional, ignoring the spatial variation along the direction of the tail current. A discussion of equilibria is based on the assumption of an isotropic pressure. One of the conclusions is that the transition between the dipolar and the tail region will take place over a fairly short distance. The analytical results are supplemented by a numerical example. Properties of configurations containing field line loops are investigated. A stability discussion includes the effect of the net magnetic flux through the neutral sheet. The results have consequences for current magnetospheric problems. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

11611 (LA-5241-MS) PHOTON EMISSION FROM GASES INDUCED BY TRITIUM BETA DECAY. Ragan, C. E. III. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. Contract W-7405-eng-36. up. Dep. NTIS $3.00.

The light emitted when deuterium (D_2) and neon gas are bombarded with the beta particles from a tritium (T_2) source (~2 mCi) has been studied using tritium absorbed in a titanium backing. When an RCA 8575 phototube was used as a detector, the light from the neon produced about 30 times as much anode current as the light from the D_2. Filters were used to determine that most of the light from D_2 has wavelengths <4000 Å, while most of the light from neon has wavelengths >4000 Å. The phototube anode current increased by a factor of 20 when the window interior of a D_2-filled vessel was coated with a wavelength shifter, sodium salicylate. Pressure effects on the light emitted were also studied up to 150 psi, and it was determined that the light intensity does not decrease as fast as 1/pressure for either D_2 or neon. Visual observations were made with the unaided eye, an RCA 8606 image intensifier (gain ~10^4), and a far ultraviolet-sensitive image converter (gain ~30); photographs were obtained where possible using Polaroid 3000-speed film.

Atomic and Molecular Properties

Refer also to abstracts 11357, 11358, and 11813.

11612 QUENCHING OF THE 2 $^1S_0$ METASTABLE STATE OF HELIUM BY AN ELECTRIC FIELD. Johnson, C. E. (Univ. of California, Berkeley). Phys. Rev., A; 7: No. 3, 872-880(Mar 1973)

A time-of-flight technique was used to measure the quenching of the 2 $^1S_0$ metastable state of helium by a static electric field. Neutral ground-state helium atoms effusing from a cooled source slit are immediately excited to the 2 $^1S_0$ and 2 $^3S_1$ metastable states by a pulse of antiparallel magnetically focused electrons. The metastable beam is collimated before passing through a uniform electric field region 0.5 m long and is then preferentially detected at the end of the time-of-flight region, 1.825 m from the electron gun. The time-of-flight distribution for the 2 $^1S_0$ state is separated from that of the 2 $^3S_1$ state by illuminating the beam before the electric field region with an rf-discharge helium lamp. The 2 $^1S_0$ state is quenched by resonant absorption of a 20 581-Å photon, raising the atom to the 2 $^1P_1$ state, which then decays to the $^1S_0$ ground state; the 2 $^3S_1$ state remains unaffected because it is the ground state for the triplet system. The 2 $^1S_0$ time-of-flight distribution is therefore obtained from the difference between the full beam and the quenched beam. The number of 2 $^1S_0$ atoms arriving at the detector in specific velocity intervals with the electric field off is compared to the number with the field on to determine the quenching rate (= k E^2). The result for the quenching constant k for both ^{3}He and ^{4}He with E in kV/cm is k = 0.933 ± 0.005; this value is in good agreement with theory and with an earlier less accurate experiment. The error in the present experiment arises from a 0.5% uncertainty in the effective length of the electric field region. (auth)

11613 GENERALIZATION GREEN FUNCTION FOR THE EXCITED STATE OF H. Niemczyk, S. J. (Michigan State Univ., East Lansing). Chemical Physics Letters; 20: No. 1, 146-150(1 May 1973).

The generalized Green function for the excited states of the hydrogen atom is obtained in a partial-wave expansion. (auth)

11614 CRUDE ADIABATIC MOLECULAR VIBRONIC STATES, AND THEIR USE IN THE INTERPRETATION OF RADIATIONLESS PROCESSES IN MOLECULES. Atabek, O.; Hardisson, A.; Lefebvre, R. (Labortoire de Photosphysique Moleculaire, Orsay, FR). Chemical Physics Letters; 20: No. 1, 40-44(1 May 1973).

In order to clarify the meaning of crude adiabatic vibronic states, the use of which has been repeatedly advocated as a possible starting point for the study of radiationless processes in polyatomic molecules, the determination of such states for two diatomics, H_2 and N_2 is explicitly carried out. Ground-state crude adiabatic potential energies of the molecules H_2 and N_2 were calculated using Hartree–Fock molecular wave functions. The calculated zero-point energies are 4179 cm^{-1} for H_2 (exp: 2168 cm^{-1}) and 21826 cm^{-1} for N_2 (exp: 1176 cm^{-1}). Semi-crude calculations for N_2 (the core orbitals are allowed to follow the nuclei) yield 2979 cm^{-1} with a minimum basis set and 4320 cm^{-1} with a double ζ basis set. These calculations indicate that vibronic crude adiabatic wave functions give a very poor representation of molecular states. (auth)

11615 FORBIDDEN TRANSITION $L_{II}N_{II}$ IN THE SPECTRUM OF GADOLINIUM. Nigam, A. N.; Kapoor, Q. S. (Univ. of Rajasthan, Japiur, India). Chemical Physics Letters; 20: No. 2, 219-220(15 May 1973).

Using a 40 cm curved mica crystal spectrograph of the transmission type, the L spectrum of gadolinium was investigated. The forbidden transition $L_{II}N_{II}$ at λ = 1618.9 X. U. was reported for the first time. (auth)

11616 ELECTRONIC EXCITATION ENERGY TRANSFER BETWEEN Tb^{3+} AND Eu^{3+} IN DMSO. Chrysochoos, J.; Evers, A. (Univ., Toledo). Chemical Physics Letters; 20: No. 2, 174-177(15 May 1973).

Excitation of Tb^{3+} and Eu^{3+} in DMSO with 487 mμ, which corresponds to the $^7F_6 \rightarrow {}^5D_4$ transition of Tb^{3+}, is accompanied by a reduction in the fluorescence efficiency of Tb^{3+} as $[Eu^{3+}]$ increases and by the appearance of a weak emission from Eu^{3+}. An average rate constant for both the fluorescence quenching of Tb^{3+} and the energy transfer from Tb^{3+} to Eu^{3+} with subsequent emission from the latter, was found to be $(2.2 \pm 0.4) \times 10^3\ M^{-1}\ sec^{-1}$. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 11693, 11698, and 11708.

Collision Phenomena

Refer also to abstract 11629.

11617 (CONF-720994–1) ATOM IN A POWERFUL LIGHT FIELD. Delone, N. B. (Akademiya Nauk SSSR, Moscow. Fizicheskii Institut). 1973. 32p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.75.

From all-union conference on the physics of electron and atom collisions; Uzhgorod, Czechoslovakia (20 Sep 1972).

In this small monograph on the atom-light interactions, in which interest has been renewed since laser development, "strong light" is roughly defined as up to 10^7 V/cm. Special topics considered include many-quantum ionizations and the tunnel effect in an alternating field, the applicability of perturbation theory in describing many-photon processes, and the dependence of the character of the process of many-photon ionization on parameters which determine the atomic system and the light field. Later sections are devoted to the multiphoton ionization process in the absence of resonances, multiphoton resonance, and strong perturbations in electron states. (54 references) (KSW)

11618 QUANTUM EFFECTS OF SCATTERING OF ATOMS H AND D ON RARE GASES. Kamyshov, N. V. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 1, 107-109(1973). (In Russian).

The quantum effects of elastic scattering of atoms H and D on rare gases were analyzed. The analysis of the experimental data on elastic scattering of atoms H and D in terms of classical mechanics has shown that quantum effects are negligible. (auth)

11619 EXCITATION OF HIGHLY EXCITED HYDROGENIC IONS AND ATOMS BY CHARGED PARTICLES. 4. Richards, D. (Bradford Univ., Eng.). J. Phys., B (London); 6: No. 5, 823-836(May 1973).

It is shown that the Born approximation and the sudden-dipole approximation, when applied to the excitation of hydrogenic ions by charged particles, may be cast into the same mathematical form although their regions of validity are complementary. The resulting matrix elements are evaluated using Heisenberg's correspondence principle, and the cross sections are obtained in analytic form for a wide range of incident energies. The results for the Born approximation, which are valid for all initial and final states, n and n′ such that $n \gg |n-n'|$, are compared with available quantal calculations for small n and n′ with satisfactory agreement. (auth)

11620 CLASSICAL THEORY OF ELASTIC SCATTERING AND VIBRO ROTATIONAL DISSOCIATION IN N_2^+ ON He COLLISIONS AT MODERATE ENERGIES (0.5 keV TO 3 keV). Baudon, J. J. Phys., B (London); 6: No. 5, 850-861(May 1973).

The scattering of N_2^+ ions by He atoms at mean energy (a few keV) and small angle (θ_{lab} < 6 degrees), is studied from a classical point of view, excluding any electronic excitation. A two centre-screened Coulomb model is taken for the scattering potential. In

a first step the classical deflection function is determined for a specific molecular orientation, in assuming that the vibrational and rotational motions are negligible during the collision time. Then the corresponding differential cross section is calculated for an isotropic distribution of the molecular orientations. In a second step the amount of translational energy transferred into the internal degrees of freedom is evaluated and the vibro-rotational dissociation is taken into account. The "pseudo-elastic" differential cross section is obtained and it is compared to experiment. The agreement between theory and experiment is generally rather good at large enough value of the scattering angle. For reduced angles $\tau = E\theta$ smaller than 2 keV deg, the theoretical cross sections are smaller than the experimental ones. This is probably due to the inadequacy of screened Coulomb potentials at large internuclear distances and also to the dissociation via electronic excitation of the molecular ion. (auth)

11621 VACENCY OCCUPATION PROBABILITIES IN ION-ATOM COLLISIONS. Macek, J. H.; Briggs, J. S. (Univ. of Nebraska, Lincoln). J. Phys., B (London); 6: No. 5, 841-849 (May 1973).

Certain statistical factors which govern the probability that an electron or vacancy is initially in one of the molecular states used in the Fano–Lichten model (Phys. Rev. Lett.; 14: 627-9 (1965)) of heavy ion collisions are calculated. Expressions for the probabilities p_i that a molecular orbital contains i vacancies are given in terms of overlap integrals involving the asymptotic wave functions of the collision partners. The basis for the calculation and the relation of these factors to measurable quantities is discussed. (auth)

11622 USE OF SECOND ORDER POTENTIALS IN THE THEORY OF SCATTERING OF CHARGED PARTICLES BY ATOMS. 5. Excitation of Helium Atoms by Fast Protons and Charge Exchange. Begum, S.; Bransden, B. H.; Coleman, J. (Univ. of Durham, Eng.). J. Phys., B (London); 6: No. 5, 837-840 (May 1973).

Cross sections are calculated for the excitation by protons of ground state helium to the 2^1S and 2^1P levels at incident energies in the interval 25 to 500 keV, using the second order potential approximation of Bransden and Coleman (J. Phys. B. Atom. Molec. Phys.; 5: 537-45(1972)). Cross sections are also calculated for electron capture by protons from helium at energies above 100 keV, using a distorted wave approximation. (auth)

11623 APPLICATION OF CLASSICAL COLLISION THEORY TO ELECTRON IMPACT DOUBLE IONIZATION OF ATOMS. Roy, B. N.; Rai, D. K. (Banaras Hindu Univ., India). J. Phys., B (London); 6: No. 5, 816-822 (May 1973).

The classical binary encounter theory in its symmetrical form was applied to the double ionization of He and Li^+. Process of double ionization was assumed to proceed via double encounter. In both encounters correct quantum mechanical velocity distributions for the bound electron were used. The results are compared with experimental observations and earlier calculations by Gryzinski's method (Phys. Rev.; 138A; 305-21 and 322-35 and 336-58 (1965)). It is concluded that the single encounter model suggested by Mittleman (Phys. Rev. Lett.; 16: 498-9(1966)) is not entirely correct and substantial contributions are made by double encounter process. (auth)

11624 TIME-REVERSAL IN THE IMPACT PARAMETER METHOD. Shakeshaft, R.; Macek, J.; Gerjuoy, E. (New York Univ.). J. Phys., B (London); 6: No. 5, 794-802 (May 1973).

In the impact parameter method the electron Hamiltonian depends upon the time through the motion of the nuclei and the consequences of time-reversal invariance are less obvious than they are for time-independent Hamiltonians. Use is made of the hermiticity of the electron Hamiltonian and its invariance under time-reversal to derive some useful relations occurring in the impact parameter method. A basis set of either atomic or molecular eigenfunctions, which exploit the reflection symmetry in the scattering plane, is adopted, and a quantization axis is chosen which may be fixed or rotating. Systems of arbitrary spin are considered and it is required only that nuclei move in a central (but unspecified) potential. (auth)

11625 EXCITATION CROSS SECTIONS FOR Cs II LINES DUE TO COLLISIONS OF Cs^+ IONS WITH He, Ne, AND Ar ATOMS. Zapesochnyi, I. P.; Pop, S. S. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 3, 226-229(Sep 1972).

Translated from Opt. Spektrosk.; 33: No. 3, 419-424(Sep 1972).

Excitation functions were measured in absolute units for many Cs II spectral lines produced by collisions of Cs^+ ions with He, Ne, and Ar atoms in the ion energy range from the excitation threshold to 28 keV. It was found that with increasing atomic number of target particles, the excitation cross sections of the same Cs II lines increase appreciably, and their dependence on the ion energy becomes more complex. For given pairs of colliding particles, the apparent threshold energy values of the excitation of Cs II lines were determined. The results of the investigations are discussed qualitatively on the basis of the representations of pseudointersections of the potential energy curves. (auth)

11626 2s → 2p TRANSITIONS IN A HYDROGEN ATOM DURING A COLLISION WITH ATOMS OF AN INERT GAS. Kvlividze, V. A.; Svotin, P. A. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 1, 104-105(1973). (In Russian).

Transitions of an atom of hydrogen from a metastable state 2s → 2p during a collision with a charged particle is commonly studied in connection with the decay rate of the metastable state. Similar processes involving a neutral particle are considered. For an atom of an inert gas in its basic state, the cross section may exceed the gas-kinetic diameter by two orders of magnitude. (KSW).

11627 ANGULAR AND ELECTRICAL DISTRIBUTION OF ELECTRONS EJECTED DURING COLLISIONS OF HELIUM ATOMS WITH FAST ELECTRONS. Balashov, V. V.; Lipovetskii, S. S.; Senashenko, V. S. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 1, 116-119(1973). (In Russian).

The fast-electron induced ionization of He was considered in a Born approximation. The angular and electrical distributions corresponding to direct transitions of an atomic electron in a continuous spectrum were calculated. (KSW)

Atomic Theory

11628 GEOMETRICAL REALIZATION OF THE AUFBAU SCHEME. Berrondo, M.; Novaro, O. A. (Universidad Nacional Autonoma de Mexico, Mexico City). J. Phys., B (London); 6: No. 5, 761-769(May 1973).

The periodic system of Mendeleev provides one with a compact description of the chemical properties of the elements and permits a global overview of atomic shell structure. It is true, however, that many questions concerning the theoretical understanding of the table of the elements still remain open. In particular the existence of atomic magic numbers associated with noble gas behavior has led to a search for approximate hidden symmetries. Such a symmetry is obtained here without any postulates. Instead, Fock's analysis of the hydrogen atom projecting it on a 4-dimensional hypersphere is followed. In this case the corresponding mapped system is the quantal top in 4-dimensions. The top's symmetry group G provides representations corresponding exactly to the periods of Mendeleev. The chain $G \supset O(4) \supset SO(3)$ yields the quantum numbers n, l necessary for predicting the correct subshell ordering through a modified Aufbau scheme. Finally the noninvariance groups of G are obtained. Every step in this procedure is justified purely through group theoretical considerations. (auth)

11629 IMPACT OF COMPUTERS ON ATOMIC PHYSICS. Burke, P. G. (Queen's Univ., Belfast). Comput. Phys. Commun., Suppl.; 3: 1-13(Sep 1972).

The review of the use of computers for atomic physics covers the two-electron and the many-electron bound state problems, and electron–atom scattering. (JFP)

11630 PHYSICS OF ATOMS AND MOLECULES. An Introduction to the Structure of Matter. Fano, U.; Fano, L. Chicago; University of Chicago Press (1972). 603p. $14.50.

The topics covered are the basic evidence on the macroscopic and quantum properties of atoms, concepts and phenomena of quantum physics, the mechanics of single atoms, and aggregates of atoms. (JFP)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

11631 VARIATIONAL PRINCIPLE AND THE VIRIAL THEOREM FOR UNIFORMLY ROTATING MAGNETOHYDRODYNAMIC SYSTEMS. Frazer, M. C. (Univ. of Alberta, Edmonton). Quart. J. Mech. Appl. Math.; 26: 129-142(May 1973).

A variational expression is derived for the frequency of small oscillations about an equilibrium state of a compressible, viscous, self-gravitating, uniformly rotating, isotropic, magnetic fluid system. The equivalence of this principle and the tensor form of the virial theorem for the same system is demonstrated. (auth)

11632 UNSTEADY MHD DUCT FLOW BY THE FINITE ELEMENT METHOD. Wu, S. T. (Univ. of Alabama, Huntsville). Int. J. Numer. Methods Eng.; 6: No. 1, 3-10(1973).

The finite element method is applied to seek an approximate numerical solution to a class of unsteady magnetohydrodynamic flow in ducts with arbitrary cross-section. A consistent discrete model for the MHD flow equation with a small magnetic Reynolds number has been developed via the concept of finite elements. A numerical example of MHD flow in a rectangular duct is given, and its results of velocity profiles are compared with the results obtained by other methods. (auth)

11633 GEOMETRY OF STREAMLINE IN HYDROMAGNETIC FLUID FLOWS. Purushotham, G. (Nagarjunasagar Engineering Coll., Hyderabad, India). Tensor; 25: 229-237(1972).

The kinematic properties of hydromagnetic flows are studied, omitting the basic two superfluous hypotheses assumed previously, i.e., the vanishing of the electrical resistivity and the assignment of the unidirection to the magnetic field throughout the region of flow. Thus the analysis presented is more general and particular types of flows can be deduced as special cases of these. (JFP)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

11634 (LBL-1050) PHYSICS ANNUAL REPORT, JULY 1971–JUNE 1972. Wenzel, W. A. (California Univ., Berkeley. Lawrence Berkeley Lab.). 1972. Contract W-7405-eng-48. 115p. Dep. NTIS $5.45.

Accelerators (Bevatron, 184-inch synchrocyclotron, accelerator studies), experimental and theoretical high-energy physics, and mathematics and computing are reported. Work on atomic beams and their reactions, controlled thermonuclear research and plasma physics, health physics, and nuclear emulsions is included. Only very brief descriptions are provided; references to reports and publications are given. (RWR)

Electromagnetic

Refer also to abstracts 11405 and 11887.

11635 (BNL-17861) SEARCH FOR HIGH ENERGY MULTI-GAMMA EVENTS AT THE ISR. Yuan, L. C. L.; Dell, G. F.; Uto, H.; Amaldi, E.; Beneventano, M.; Borgia, B.; Pistilli, P.; Sestilli, I.; Docher, J. P. (Brookhaven National Lab., Upton, N. Y.; Rome Univ. (Italy). Istituto di Fisica; Grumman Aircraft Engineering Corp., Bethpage, N. Y.). [nd]. 15p. (CONF-730320-1). Dep. NTIS $3.00.

From conference on high energy particle interactions; Nashville, Tennessee, USA (26 Mar 1973).

The preliminary results of the exploratory experiment at the CERN ISR on the search for multigamma events in proton-proton collisions are reported. In this experiment an overwhelmingly large number of multigamma events especially at high multiplicities were observed. The preliminary results also show a prominent peak in the energy distribution of the individual γ rays as measured by the 3-radiation lengths thick lead glass Cerenkov counters under the present triggering conditions. (auth)

11636 (COO-3065-32) MUON–PROTON SCATTERING AT HIGH MOMENTUM TRANSFERS. Kostoulas, I. G. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 1972. Contract AT(11-1)-3065. 244p. (UR-415). Dep. NTIS $14.25.

Thesis.

An experiment was performed to search for muon-electron "universality" through a complete comparison of e-p and μ-p elastic and inelastic scattering. The experiment was performed at Brookhaven National Laboratory where a special muon beam was constructed yielding up to 3×10^6 muons/AGS pulse, incident on a 48 in. hydrogen target. The data demonstrate close similarity with electron-proton scattering, the behavior in q^2 and ν being identical. Comparison of the elastic data with the e-p scattering experiments indicates agreement within the error of measurement (both for the electron and muon data). However the μ-p elastic cross section is lower by about 6% as in previous μ-p experiments. This discrepancy is at the limit of the relative normalization error. The inelastic scattering indicates that the structure function νW_2 of the proton is not a function of q^2 and ν separately but a function of the dimensionless ratio $\omega = 2m_p\nu/q^2$. Namely, as q^2 and ν are scaled proportionally, νW_2 remains invariant which behavior is completely different from elastic scattering. Such behavior of the structure function νW_2 and the large values of the inelastic scattering cross section at high q^2 can be accounted for by assuming that the nucleon consists of point like charged particles, the "partons." (auth)

11637 η-MESON PHOTOPRODUCTION ON NUCLEI AND DETERMINATION OF ηN-INTERACTION TOTAL CROSS SECTION. Abrahamian, L. O.; Aganiants, A. O.; Adamian, F. V.; Demiokhina, N. A.; Gevorkian, S. R.; Israelian, M. Kh.; Kazarian, G. Kh.; Khudaverdian, A. G.; Khurshudian, L. S.; Lebedev, A. N.; Manukian, I. V.; Muradian, E. C.; Piliposian, S.; Sirunian, A. M.; Vartapetian, H. A.; Vatian, A. L. (Inst. of Physics, Erevan). Phys. Lett., 44B: No. 3, 301-304(30 Apr 1973).

The reaction $\gamma A \rightarrow A'\eta$ was studied on Be, C, Al, Cu, Ag and Pb targets at $E_\gamma = 2$GeV and $|t| = 0.5$ (GeV/c)^2. Experimental data are analyzed in the Glauber-Margolis theory framework to get the total $\sigma_{\eta N}$ cross section. This result is dependent on the value of the ratio of differential cross sections of η-meson photoproduction from neutrons and protons R, and agrees with the quark model value of $\sigma_{\eta N}$ 20 mb for R ranging from 0.3 to 0.6. (auth)

11638 ELECTRON-PHOTON SHOWERS IN LEAD IN THE 150 TO 550 MeV ENERGY REGION. Belousov, A. S.; Malinovskii, E. I.; Rusakov, S. V.; Samedov, V. V.; Shareiko, P. N. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 17: No. 5, 1028-1033 (May 1973). (In Russian).

The cascade curves and angular divergence are measured of the showers produced in lead by 150 to 550 MeV electrons. The characteristics of the showers are determined by analyzing the amplitude distributions of the moments of the high amplitude resolution scintillation counter used for measurement of the number of electrons in the shower. All shower characteristics are obtained for the 5 MeV cut-off energy of the secondary electron spectrum. The shower integral ranges are determined and the coefficient is found taking into account the cut-off energy. The possibility is investigated of using the scintillation counter for determination of the electron and γ energies by the number of particles forming the shower maximum. The experiments are carried out with the Lebedev Physical Institute electron synchrotron and the electron beam from the Serpukhov proton synchrotron. (auth)

11639 PRODUCTION OF K_L^0 MESONS AND NEUTRONS FROM ELECTRONS ON BERYLLIUM ABOVE 10 GEV. Brandenburg, G. W.; Brody, A. D.; Johnson, W. B.; Leith, D. W. G. S.; Loos, J. S.; (and others) (Stanford Linear Accelerator Center, Stanford, University, Stanford, California 94305). Phys. Rev. D 7: No. 3, 708-721 (1 Feb 1973).

Measurements are presented of the yields of K_L^0 mesons and neutrons produced by electrons of energies between 10 and 19 GeV incident on 0.70- and 1.75-radiation-length beryllium targets for production angles between 1.6° and 4°. Values for the K_L^0 absorption cross section on lead are also found for momenta between 1.4 and 7.4 GeV/c. A successful interpretation of K_L^0 production is made in terms of the process $\gamma N \rightarrow K_L^0 X$, where X represents an inclusive sum over all final states. The invariant structure function for K_L^0 photoproduction, extracted from the Be yields, is found to be simply related to the result for hydrogen by an over-all multiplicative factor, A_{eff}, the effective number of nucleons in the target nucleus. The results of the theoretical analysis are also compared to charged-K photoproduction and extrapolated to electron energies of 50 GeV. (auth)

11640 PROOF OF COMPARABLE K-PAIR AND π-PAIR PRODUCTION FROM TIME-LIKE PHOTONS OF 1.5, 1.6, AND 1.7 GeV AND DETERMINATION OF THE K-MESON ELECTROMAGNETIC FORM FACTOR. Bernardini, M.; Bollini, D.; Brunini, P. L.; Fiorentino, E.; Massam, T.; Monari, L.; Palmonari, F.; Rimondi, F.; Zichichi, A. (CERN, Geneva). Phys. Lett.; 44B: No. 4, 394-396(14 May 1973).

The observation of 21 K^+K^- pairs in 38 hadron pair events produced at 1.5, 1.6, and 1.7 GeV total center-of-mass energies in e^+e^- annihilations, establishes that time-like photons produce K pairs and π pairs with comparable rates in this energy range. The K-meson electromagnetic form factor at a mean s-value of 2.4 GeV^2 is measured to be $|F_K| = 0.50 \pm 0.08$. The number of e^+e^- pairs observed in the same angular and energy range is 5148. (auth)

11641 PHOTOPRODUCTION OF TWO PIONS IN THE ENERGY RANGE OF 4.1 TO 6.2 GEV. Aachen–Hamburg–Heidelberg–Munich Collaboration. Nucl. Phys.; B57: No. 1, 1-17(1973).

The reaction $\gamma p \rightarrow \pi^+\pi^- p$ in the energy range 4.1 to 6.2 GeV was studied with a tagged photon beam incident on a liquid hydrogen target in the DESY one-meter streamer chamber. The reaction is analyzed in terms of the longitudinal phase space (LPS) method. The one-pion-exchange model for $\Delta(1236)$ production and decay is examined. For the diffractive part of the LPS a dual model with pomeron exchange is investigated. In particular, the s-channel helicity conservation dual model of Dewey and Humpert describes the data well. (auth)

Weak

11642 (SLAC-155) CHARGE ASYMMETRY IN $K_L^0 \rightarrow \pi\mu\nu$. Piccioni, R. L. (Stanford Linear Accelerator Center, Calif.). Sep 1972. Contract AT(04-3)-515. 84p. Dep. NTIS $5.45.

Thesis.

For $\Gamma_\pm \equiv$ Rate $(K_L^0 \rightarrow \pi^\mp\mu^\pm\nu)$, the charge asymmetry, $\delta \equiv (\Gamma_+ - \Gamma_-)/(\Gamma_+ + \Gamma_-)$, was measured to be $(+0.28 \pm 0.05)\%$. Such an asymmetry is evidence of CP violation. The result was compared with previous CP violation experiments in this and other decay modes of the neutral kaon. Consistency among the experiments and consistency with the predictions of the superweak theory were found. (auth)

11643 CHARGE ASYMMETRY IN THE DECAY $K_L^0 \rightarrow \pi\mu\nu$. McCarthy, R. L.; Brewer, J. H.; Budnitz, R. J.; Entis, A. C.; Graven, R. M.; (and others) (Lawrence Berkeley Laboratory, University of

California, Berkeley, California 94720). Phys. Rev. D 7: No. 3, 687-708 (1 Feb 1973).

If $\Gamma_\pm = \mathrm{Rate}(K_L^0 \to \pi^\pm \mu^\pm \nu)$, the $K_{\mu 3}^0$ charge asymmetry is $\delta = (\Gamma_+ - \Gamma_-)/(\Gamma_+ + \Gamma_-)$. This number has been measured to be $(6.0 \pm 1.4) \times 10^{-3}$ at the Lawrence Berkeley Laboratory's Bevatron. The error is meant to be interpreted as one standard deviation and contains a major systematic contribution. Large corrections were made in order to exclude neutron-induced background events and to correct for the range difference between μ^+ and μ^-. The meaning of the possible difference between muonic and electronic charge asymmetries is discussed. (auth)

Strong (Baryon-induced)

Refer also to abstract 11823.

11644 (COO-1428-322) NOVEL TECHNIQUE TO STUDY DIFFRACTIVE BARYON RESONANCES. Anderson, E. W.; Erwin, A. R.; Fisher, G. P. (Purdue Univ., Lafayette, Ind. Dept. of Physics). [nd]. Contract AT(11-1)-1428. 6p. Dep. NTIS $3.00.

The Multiparticle Argo Spectrometer System, consisting of a high-momentum spectrometer, a low-momentum spectrometer, and a magnetic vertex spectrometer, was used to study charged particles in the final states from pp interactions using the diffracted proton beam of 28.5 GeV/c. The spectrometer characteristics and plots of missing mass distributions are given. It is remarked that the practical feasibility of studying diffractive N* production with automatic spark chamber techniques is demonstrated. (LBS)

11645 (COO-2146-3) NUCLEON–NUCLEON POLARIZATION CORRELATION EXPERIMENTS IN THE 300 TO 800 MeV RANGE. Technical Progress Report for a Program in Medium Energy Nuclear Physics Research, September 1, 1972–August 31, 1973. Willard, H. B. (Case-Western Reserve Univ., Cleveland, Ohio. Dept. of Physics). 25 May 1973. Contract AT(11-1)-2146. 9p. Dep. NTIS $3.00.

The preparation and development of equipment for research on nucleon–nucleon polarization correlation experiments is summarized. (JFP)

11646 (COO-3065-25) SINGLE-PARTICLE INCLUSIVE REACTIONS. Ferbel, T. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 29 Sep 1972. Contract AT(11-1)-3065. 48p. (CONF-720640-2; UR-408). Dep. NTIS $4.50.

From 3rd international conference on many-body reactions; Zakopane, Portugal (20 Jun 1972).

The review of the status of single-particle inclusive interactions covers $\pi + p$, $\gamma + p$, $p + p$, and $K + p$ interactions. (JFP)

11647 (COO-3065-33) EVIDENCE FOR A DIFFRACTIVE COMPONENT IN MULTIPARTICLE PRODUCTION AT 102 GeV. Bromberg, C. M.; Cohen, D.; Ferbel, T.; Slattery, P.; Chapman, J. W.; Green, N.; Roe, B. P.; Seidl, A. A.; Vander Velde, J. C. (Rochester Univ., N. Y.; Michigan Univ., Ann Arbor). 1973. 11p. (UMBC-72-14; UR-416). Dep. NTIS $3.00.

An estimate of the inelastic diffractive cross section was obtained by measuring the spectrum of slow recoil protons coming from interactions of 102-GeV protons in hydrogen. The data are from a preliminary 5000 picture exposure of the NAL 30-inch bubble chamber. A value was found for the total cross section for single diffractive dissociation of 6.8 ± 1.0 mb, mainly contributed by the two-pronged and four-pronged topologies. (auth)

11648 (FRNC-TH-325) SEARCH FOR $\Delta^\pm$ MESONS, D^0 AND X^0 IN THE ANNIHILATION OF ANTIPROTONS INTO SEVEN PIONS, AT 1.2 GeV/c. Cousinou, M. C. (Paris Univ. (France)). 1972. 74p. (In French). NTIS (U.S. Sales Only).

Thesis.

The cross sections of the antiproton proton $\to 3\pi^+, 3\pi^-$, antiproton proton $\to 3\pi^+ 3\pi^- \pi^0$, and antiproton proton $\to 3\pi^+ 3\pi^- (n\pi^0)$ $(n \geq 2)$ reactions at 1.2 GeV/c were studied. The rates of production for ω^0, η^0, and X^0 resonances were determined for the antiproton proton $\to 3\pi^+ 3\pi^- \pi^0$ reaction using the maximum likelihood method and the selection of events by cuts. The possible existence of $\Delta^\pm$ mesons and D^0 in the $\eta\pi$ and $\eta\pi\pi$ mass spectra was investigated. The production of $\Delta^\pm$ mesons (if they exist) is sufficiently insignificant to be masked by the reflection of ω^0. Some scanty evidence of the decay of D^0 into $\eta\pi^+\pi^-$ was obtained. An attempt was made to establish a value for the branching ratio of the decay modes: D^0 into $\eta\pi\pi$ and $K\bar{K}$ $(R = 3 \pm 2.5)$. Theoretical values were calculated for this branching ratio using an SU_3 invariant statistical model. (France)

11649 (FRNC-TH-332) PROTON ANTIPROTON $\to \eta\pi\pi$ (AT REST) ANNIHILATIONS AND MEASUREMENT OF THE DECAY RATIOS OF η_0. Espigat, P. (Paris Univ. (France)). 1971. 79p. (In French). NTIS (U.S. Sales Only).

Thesis.

Some η meson production rates were measured in an antiproton experiment. The following disintegration ratios were determined: $R_1 = \eta \to$ neutral particle$/\eta \to \pi^+\pi^-\pi^0 = 2.61 \pm 0.75$ and $R_2 = \eta \to \pi^+\pi^-\gamma/\eta \to \pi^+\pi^-\pi^0 = 0.36 \pm 0.08$. The antiproton proton $\to \eta\pi^+\pi^-$ reaction was then studied using the final state interaction model. It was discovered that this reaction is dominated by the antiproton proton $\to A_2^\pm \pi^\pm$, $[A_2 \to \eta\pi]$ (41%), and the antiproton proton $\to \eta\rho$ (36%) channels, the value of A_2 being fixed at 1330 MeV/c^2 with a width of 100 MeV/c^2. The branching ratios of the following disintegrations were calculated: $A_2 \to \eta\pi/A_2 \to \rho\pi = 0.15 \pm 0.04$ and $A_2 \to \eta\pi/A_2 \to K\bar{K} = 6.5 \pm 1.6$ together with the production rate of the reaction antiproton proton $\to A_2\pi$/antiproton proton $\to$ all annihilations $= (6.40 \pm 0.8)10^{-2}$. The analysis of the same events with the Veneziano model led to slightly different conclusions. It is emphasized that the small number of results obtained in the experiment limits the interpretation of the reaction. (France)

11650 RAPIDITY CORRELATIONS IN INCLUSIVE TWO-PARTICLE PRODUCTION AT STORAGE RING ENERGIES. CERN-Hamburg-Vienna Phys. Lett., 44B: 313-316(30 Apr 1973).

Inclusive two-particle production in the reaction $pp \to \gamma + ch +$ (anything) was measured at the CERN ISR for four energies ($\sqrt{s}$ = 23, 30.5, 45, and 53 GeV) at two production angles of the charged particles (ch) and at eight production angles of the γ-rays. The rapidity correlation of the two particles is weak and of short range. The peak correlation is $\sigma_{\mathrm{inel}}(d^2\sigma_{\gamma ch}/d\sigma_\gamma\, d\sigma_{ch}) - 1 = 0.62 \pm 0.08$, the correlation range $(y_\gamma - y_{ch}) = 1.17 \pm 0.05$, independently of s. The ϕ correlation extends over a wide gap in rapidity; its strength is increasing with increasing transverse momentum. (auth)

11651 REACTION $\bar{p}P$–$\bar{p}P\pi^+\pi^-$ BETWEEN 1.6 AND 2.2 GeV/c. Lys, J.; Chapman, J. W.; Green, R. (The University of Michigan, Ann Arbor, Michigan 48104); Murphy, C. T. Phys. Rev. D 7: No. 3, 610-621 (1 Feb 1973).

The cross section for the reaction $\bar{p}p$–$\bar{p}p\pi^+\pi^-$ has been measured at laboratory momenta between 1.62 and 2.20 GeV/c (center-of-mass energy 2294 to 2500 MeV). The cross section rises from 50 ± 16 μb to 975 ± 55 μb in this region, the major rise occurring as the ΔΔ threshold is crossed around 2465 MeV. The effective mass and angular distributions do not agree well with the one-pion-exchange model of Wolf, which includes off-mass-shell corrections. Various possible causes of the disagreement are discussed. (auth)

11652 PP ANNIHILATIONS INTO $\pi^+\pi^-$, K^+K^-, $\pi^+\pi^-\pi^0$, AND $\pi^+\pi^-$ + NEUTRALS NEAR CENTER-OF-MASS ENERGY 2200 MEV. Bacon, T. C.; Butterworth, I.; Miller, R. J.; Phelan, J. J. (Rutherford High Energy Laboratory, Chilton, Didcot, United Kingdom); Donald, R.; (and others). Phys. Rev. D 7: No. 3, 577-584 (1 Feb 1973).

The two-prong annihilation channels for the $\bar{p}p$ interaction at four center-of-mass energies between 2150 and 2240 MeV are described. The angular distribution in the dipion annihilations are in detail different from those obtained in a previous experiment. Resonance contributions in final states involving one or more neutrals are estimated. No evidence of formation of the T(2195) meson is observed. (auth)

11653 INTERACTION LENGTHS OF ENERGETIC PIONS AND PROTONS IN IRON. Crannell, Hall (Department of Physics, The Catholic University of America, Washington, D.C. 20017); Crannell, Carol Jo; Whiteside, Haven; Ormes, Jonathan F.; Ryan, Michael J. Phys. Rev. D 7: No. 3, 730-740 (1 Feb 1973).

The interaction lengths of pions and protons in iron have been measured using and ionization spectrometer composed of alternating layers of iron and plastic scintillator. These measurements cover an energy range from 9.3 to 18 GeV. The interaction lengths were determined by accurate statistical analyses of the experimental data using the maximum-likelihood method. The dependence of the interaction length on the parameters used to define an interaction was studied, and the results reported employ parameters chosen to minimize the percentage uncertainty in the interaction length. The mean interaction length of pions was found to be approximately 20% greater than that of protons. No significant dependence on the energy of the incident primary was found in the range measured. Consistency was found with the great variety of accelerator measurements made to date, all of which report greater interaction lengths than those reported by the cosmic-ray measurements. (auth)

11654 INCLUSIVE SINGLE-PARTICLE SPECTRA OF π^-, K_S^0 AND Λ IN PROTON–PROTON COLLISIONS AT 19 GEV/c. Scandinavian Bubble Chamber Collaboration. Nucl. Phys.; B57: No. 1, 77-99(1973).

Data on the inclusive production spectra of K_S^0 and Λ from proton–proton collisions at 19 GeV are presented and discussed in connection with the earlier studied inclusive π^- production spectrum. The three single-particle spectra are compared with a crude two-center thermal model for the average radiation from the pp collisions. (auth)

Strong (Meson-induced)

11655 (ANL/HEP-7318) $\pi\pi$ AND Kπ SCATTERING STUDIES WITH THE ARGONNE EFFECTIVE MASS SPECTROMETER. Ayres, D. S.; Diebold, R.; Greene, A. F.; Kramer, S. L.; Pawlicki, A. J.; Wicklund, A. B. (Argonne National Lab., Ill.). May 1973. 14p. (CONF-730319-2). Dep. NTIS $3.00.

From international conference on π-π scattering as associated topics; Tallahassee, Florida, USA (28 Mar 1973).

A total of 580,000 events of the type $\pi^-N \to \pi^-\pi^+N$ was obtained in the region 3 to 6 GeV/c. Isolation of $\rho\omega$ interference is made in a straightforward way by using both π^+ and π^- beams with a deuterium target. An amplitude analysis of ρ^0 production at 6 GeV/c yields results similar to those previously found at 17 GeV/c, except that the natural-parity exchange contribution is relatively less important. Results on $K^+n \to K^+\pi^-p$ and $\pi^-p \to K^-K^+n$ are also discussed. (auth)

11656 (ANL/HEP-7320) ρ-ω INTERFERENCE IN THE REACTION $\pi N \to \pi\pi N$ AT 3, 4, AND 6 GeV/c. Ayres, D. S.; Diebold, R.; Greene, A. F.; Kramer, S. L.; Pawlicki, A. J.; Wicklund, A. B. (Argonne National Lab., Ill.). May 1973. 5p. (CONF-730319-3). Dep. NTIS $3.00.

From international conference on π-π scattering as associated topics; Tallahassee, Florida, USA (28 Mar 1973).

Preliminary results are presented on ρ-ω interference in a high statistics experiment on the reaction $\pi^\pm N \to \pi^+\pi^-N$ at 3, 4 and 6 GeV/c. Significant constructive (destructive) ρ-ω interference is observed in both the unnatural and natural parity exchange cross section for incident $\pi^-(\pi^+)$. This sign of the interference agrees with that predicted from exchange degenerate π-B Regge poles but disagrees with the prediction of the exchange degenerate ρ-A_2 model. (auth)

11657 (COO-3065-30) SEARCH FOR ISOTOPIC SPIN 2 MULTIPION RESONANCES. Cohen, D.; Ferbel, T.; Slattery, P.; Werner, B. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 1972. Contract AT(11-1)-3065. 16p. (UR-413). Dep. NTIS $3.00.

A search was performed for isotopic spin-2 multipion resonances in reactions of the type $\pi^-d \ll pp + x^{--}$ at an incident π^- momentum of 7 GeV/c. The sensitivity is such that a 1 μb production cross section would correspond to observing ~14 events. No evidence was found for the existence of resonance-like states in the x^{--} system, and consequently upper limits are presented for the production of such resonances in these reactions. (auth)

11658 (FRNC-TH-277) DETERMINATION OF THE POLARIZATION OF THE RECOIL PROTON IN ELASTIC SCATTERING BY POLARIZED TARGETS. Gaidot, A. (Paris Univ., (France)). 1972. 76p. (In French). NTIS (U. S. Sales Only).

Thesis.

The development of the BOUJOTTE program for the analysis of elastic π^+ scattering between 6 and 16 GeV/c is presented. The essential purpose of this program is the selection of elastic events and the calculation of the analyzing power of carbon. This latter factor was recalculated taking into account new results obtained for the scattering of protons by carbon between 60 and 300 MeV. An example of the use of this program in view of obtaining rotation and spin parameters in elastic π^-p scattering at 6 GeV/c and in the $0.2 < t < 0.5$ $(GeV/c)^2$ interval is given. The mean value found for R is of the order of -0.23 ± 0.05. This value is in agreement with the theoretical results of Cohen-Tannoudji, and Barger and Phillips. (FR)

11659 (FRNC-TH-328) STUDY OF THE $K^+p \to K^0p\pi^+$ REACTION AT 2.17 AND 2.34 GeV/c. Pessard, H. (Paris Univ. (France)). 1972. 127p. (In French). NTIS (U.S. Sales Only).

Thesis.

The $K^+p \to K^0p\pi^+$ reaction was studied experimentally at 2.17 and 2.34 GeV/c. The large number of events considered with small K^+ to K^0 momentum transfer enabled an accurate description of the differential cross section of the $K^+p \to K^0\Delta^{++}$ resonant channel to be obtained together with the density matrix elements of the Δ^{++} resonance produced. The results obtained are compared with theoretical predictions made using the single particle exchange model and the Regge model with exchange of two trajectories. (France)

11660 (FRNC-TH-330) STUDY OF $\pi^-p \to \pi^0n$ ($\pi^0 \to \gamma\gamma$) AND $\pi^-p \to \eta n$ ($\eta \to \gamma\gamma$) REACTIONS ON NUCLEI AT 7.82 GeV/c. Le Du, P. (Paris Univ. (France)). 1971. 53p. (In French). NTIS (U.S. Sales Only).

Thesis.

The $\pi^-p \to \pi^0n$ ($\pi^0 \to 2\gamma$) and $\pi^-p \to \eta n$ ($\eta \to 2\gamma$) reactions on nuclei at 8 GeV/c were studied. The following observations were made: the form of the differential cross section is independent of the nucleus studied (account being taken of the effects due to the Fermi moment of the nucleons); effects due to the Pauli exclusion principle are not observed for small transfers (less than 0.1 $(GeV/c)^2$). However the effects predicted are of the same order of magnitude as the errors. The results are compared with those of the Glauber model. It was shown that the value of the total inelastic π^0-nucleon cross section is 29 ± 8 mb and that this value is identical to the total inelastic eta-nucleon cross section. The results, however, are affected by relatively large experimental errors. (France)

11661 (FRNC-TH-331) STUDY OF THE $\pi^-p \to n\gamma$ REACTION. Le Calvez, O. (Paris Univ. (France)). 1971. 75p. (In French). NTIS (U.S. Sales Only).

Thesis.

The total s cross section of π^-p processes which give rise to neutral particles only was measured in an incident moment range from 250 to 1800 MeV/c, the measurements being made in 25 MeV/c intervals. The ratios measured between the number of final neutral events and the number of incident particles must be corrected taking into account the contamination of the incident beam and the possible conversion of the neutral particles produced into charged particles, this phenomenon resulting in a decrease in the total cross section. The correction calculations that must be applied to the experimental results are described in detail. The total cross section calculated in this way is compared with previously obtained experimental results. The agreement obtained confirmed the correct functioning of the apparatus used and the correct normalization of the differential cross section studied: $\pi^-p \to n\gamma$. (France)

11662 (JINR-P1-7103) SOME CHARACTERISTICS OF INCLUSIVE REACTIONS $\pi^-p \to \pi^\pm + \ldots$, $\pi^-n \to \pi^\pm + \ldots$ AT p = 40 GeV/c. Abdurakhimov, A. U.; Angelov, N.; Vishnevskaya, K. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 24p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.25.

The experimental data on inclusive reactions $\pi^-p \to \pi^\pm + \ldots$ and $\pi^-n \to \pi^\pm + \ldots$ at p = 40 GeV/c are presented. The absolute cross section of the reaction $\pi^-p \to \pi^\pm + \ldots$ at $x \approx 0$ coincides with the results obtained in intersecting beams at CERN at E_p = 500-1500 GeV. A similar result was obtained for inclusive processes $\pi^-p \to \gamma + \ldots$ as well. Thus, in the "central region" structural functions are similar for π^-p and pp^- collisions at E_p = 500-1500 GeV. If a scale invariance in p-p collisions takes place at E_p = 1000 GeV, in π^-p interactions one can observe it already at p = 400 GeV/c. (auth)

11663 STRENGTH OF ABSORPTION IN SINGLE PION PRODUCTION REACTIONS. Ochs, W.; Wagner, F. (Max-Planck Institut fuer Physik und Astrophysik, Munich). Phys. Lett.; 44B: No. 3, 271-274(30 Apr 1973).

From data on the reactions $\pi^-p \to \pi^-\pi^+n$ and $K^+n \to K^+\pi^-p$ the strength of absorptive corrections to the pion exchange Born term is determined as a function of the $\pi\pi$ and Kπ mass and angular momentum. (auth)

11664 TWO-PRONG EVENTS IN π^-p INTERACTIONS AT 4.45 GeV/c. Kartamyshev, A. A.; Mukhin, K. N.; Romantseva, A. S.; Sulkovskaya, M. M.; Sustavov, A. F. (Inst. of Atomic Energy, Moscow). Phys. Lett., 44B: No. 3, 310-312(30 Apr 1973).

The $(\pi^-p \to \pi^-p)_{el}$, $\pi^-p \to \pi^-\pi^+n$ and $\pi^-p \to \pi^-\pi^0p$ reactions at p_{π^-} = 4.45 GeV/c were studied in a 50 cm hydrogen bubble chamber. Cross sections σ_{tot} and $d\sigma/dt$ were measured for these reactions and also for the ρ^0, f^0 and ρ^- resonances. The elastic $\pi^-\pi^+$ and $\pi^-\pi^0$ scattering cross sections were calculated by the Chew-Low extrapolation method and with the pseudoperipheric approximation. (auth)

11665 NEAR 90° SCATTERING IN THE CHANNELS $\bar{K}^0p \to \pi^+\Lambda^0$, $\bar{K}^0p \to \pi^+\Sigma^0$, AND $K_L^0p \to K_S^0p$ FROM 1.0 TO 7.5 GeV/c. Brandenburg, G. W.; Johnson, W. B.; Leith, D. W. G. S.; Loos, J. S.; Matthews, J. A. J.; Winkelmann, F. C.; Yamartino, R. J. (Stanford Univ., CA). Phys. Lett., 44B: No. 3, 305-309(30 Apr 1973).

Differential cross sections for center of mass scattering angles near 90° are presented for the reactions $\bar{K}^0p \to \pi^+\Lambda^0$, $\bar{K}^0p \to \pi^+\Sigma^0$ and $K_L^0p \to K_S^0p$ in the momentum interval 1.0 to 7.5 GeV/c. The energy dependences of these cross sections are found to be equally well described by the parameterizations: $(d\sigma/d\Omega)_{90°} \propto s^{-n}$ or $(d\sigma/d\Omega)_{90°} \propto \exp(-bp_c)$. (auth)

11666 NEW VALUES OF PION-NUCLEON SCATTERING LENGTHS AND f^2. Bugg, D. V. (Queen Mary Coll., London); Carter, J. R. Phys. Lett., 44B: No. 3, 278-280(30 Apr 1973). 1973).

From fixed t dispersion relations more accurate values for the pion nucleon coupling constant and s-wave scattering lengths were obtained using the recent low energy πN angular distribution and

total cross section data. The results are: $f^2 = 0.0790 \pm 0.0010$, $a_1 - a_3 = 0.262 \pm 0.0004\ \mu^{-1}$, $a_1 + 2a_3 = -0.014 \pm 0.005\mu^{-1}$. (auth)

11667 STUDY OF LOW-ENERGY Σ^+n INTERACTION IN K D CAPTURE AT REST. Tan, Tai Ho (Department of Physics and Astrophysics, University of Colorado, Boulder, Colorado 80302). Phys. Rev. D 7: No. 3, 600-604 (1 Feb 1973).

The investigation is carried out via a final-state interaction process from the reaction $K\ d \to \pi^+\Sigma^+n$. In the zero-range approximation, we have found two acceptable sets of complex scattering lengths for the $I=1/2$, $^3S_1$ state to be $-(7.5\pm1.0)+i(3.0\pm1.0)$ F and $+(2.8\pm1.0)+i(3.0\pm1.0)$ F. The presence of a Σ^+n bound state remains a distinct possibility. The interaction in the $I=3/2$ $^3S_1$ state is found to be much weaker with the integrated cross section less than 8% that of the $I=1/2$ state. (auth)

11668 ANGULAR CORRELATION BETWEEN PIONS IN SIX-PRONG K^+-P INTERACTIONS AT 12.7 GEV/C. Jain, P. L.; Labuda, W. M.; Ahmad, Z.; Pappas, G. (High Energy Experimental Laboratory, Department of Physics, State University of New York at Buffalo, Buffalo, New York 14214). Phys. Rev. D 7: No. 3, 605-609 (1 Feb 1973).

The angular correlations between pions have been observed in the six-prong interactions of 12.7-GeV/c K^+ with protons. These effects have been compared with the other pion data produced with different primary particles at different energies. The influence of the production of N^* and K^* resonances on these angular correlations is investigated. (auth)

11669 ELASTIC SCATTERING AND SINGLE-PION PRODUCTION IN K^+P REACTION AT 4.27 GEV/C. Seidl, A. (The Enrico Fermi Institute and the Department of Physics, University of Chicago, Chicago, Illinois 60637). Phys. Rev. D 7: No. 3, 621-636 (1 Feb 1973).

Elastic K^+p scattering at a beam momentum of 4.27 GeV/c is studied and compared with elastic K p scattering in order to extract the imaginary part of the non-Pomeranchukon-exchange amplitude. The single-pion-production cross sections are presented as well as production cross sections and resonance parameters for the $\Delta(1236)$, the $K^{*+}(890)$, and the $K^{*+}(1420)$. Production and decay distributions for the $\Delta^{++}(1236)$ and the $K^{*+}(890)$ are presented and compared with the absorptive particle-exchange model and with Regge-pole-exchange models. (auth)

11670 ρ PRODUCTION AND DECAY IN THE REACTION $\pi^-p \to \pi^-\pi^0p$ AT 5 GEV/C. Byerly, L.; Anthony, R.; Coffin, C. T.; Meanley, E.; Meyer, D. I.; (and others) (Physics Department, University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. D 7: No. 3, 637-660 (1 Feb 1973).

Production and decay distributions of ρ from $\pi^-p \to \pi^-\pi^0p$ have been measured in an optical spark chamber experiment at 5 GeV/c. About 3000 events are obtained with $610 \leq \omega$ (dipion mass) ≤ 910 MeV/c^2 and $-0.04 \geq t \geq -0.35$ (GeV/c)^2. Our data, and ρ^- and ρ^0 data from other experiments, are used to study the ω and t dependences of the helicity frame cross sections. We find that (1) $\rho^H{}_{00}d\sigma/dt$ and $Re\rho^H{}_{10}d\sigma/dt$ are the same for ρ^- and ρ^0 production except for an over-all normalization factor (2) the ω distributions of $\rho^H{}_{11}d\sigma/dt$ and $\rho^H{}_{1-1}d\sigma/dt$ for ρ^* are strongly skewed toward low values of ω while the corresponding distributions for ρ^0 are not. The first result is shown to be reasonable in the context of a model assuming π and ω^0 exchange and absorption effects. We have not been able to explain the second result. The forward-backward asymmetry of the ρ^- decay from this experiment is significantly smaller than values from some other experiments between 2.5 and 8 GeV/c. (auth)

11671 STUDY OF $\pi\pi$ SCATTERING IN THE ISOTOPIC-SPIN-2 CHANNEL. Cohen, D.; Ferbel, T.; Slattery, P.; Werner, B. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 7: No. 3, 661-668 (1 Feb 1973).

We have carried out a study of $\pi^-\pi^-$ scattering using the reaction $\pi^-d \to pp\pi^-\pi^-$ at an incident π^- momentum of 7 GeV/c. We have extracted the isotopic-spin-2 $\pi\pi$ phase shifts and elastic cross section using a modified Chew-Low extrapolation. We obtain a value of $-7.7^\circ \pm 1.2^\circ$ for the s-wave phase shift at the K^0 mass. Our measurements are in good agreement with current-algebra predictions. (auth)

11672 SPIN-PARITY ANALYSIS OF THE A_3. Ascoli, G.; Brockway, D. V.; Eisenstein, L.; Hansen, J. D.; Ioffredo, M. L.; (and others) (Department of Physics, University of Illinois at Champaign-Urbana, Urbana, Illinois 61801). Phys. Rev. D 7: No. 3, 669-686 (1 Feb 1973).

A partial-wave analysis of the charged three-pion system in the reaction $\pi^-p \to p\pi^+\pi^-\pi^-$ for incident π^- momenta from 5 to 25 GeV/c shows the existence of a broad enhancement ($\sim$300 MeV) in the $J^P = 2^-$ $f\pi$ (S-wave) state in the region of the $A_3(1650)$. No other state ($J \leq 4$) shows structure in this region. Upper bounds for $\rho\pi$ and $\epsilon\pi$ decay modes of the A_3 are given. The interference of the $2^-f\pi$ (S-wave) amplitude with other amplitudes has been observed. The mass variation of the phase of the 2^- $f\pi$ (S-wave) amplitude measured with respect to the phases of other amplitudes does not show the behavior expected for the relative phase between resonant and nonresonant amplitudes. Results are given on the polarization and momentum-transfer dependence of the A_3 and on the A_3 production cross section as a function of incident π^- momentum. (auth)

11673 NOTE ON ISOSPIN CONSERVATION IN STRANGE-PARTICLE PRODUCTION. Lynch, J. T. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706); Walker, W. D.; Dhar, S.; Bloodworth, I.; Prentice, J. D.; (and others). Phys. Rev. D 7: No. 3, 722-724 (1 Feb 1973).

This paper reports the investigation of the reaction $\pi^+ + d \to K + \pi + \Lambda^0 + P_s$ at a bombarding energy of 7 GeV/c. A recent compilation of data concerning $\pi^- + p \to K + \pi + \Lambda^0$ showed a discrepancy in the decay $K^{*0}{}_{(890)} \to K^+ + \pi^-$ and $K^0 + \pi^0$. The discrepancy was that too few of the latter decay modes were observed as compared with isospin predictions. This paper reports further investigation which shows a considerably smaller discrepancy than that previously found. The previously noted discrepancy must have been in part produced by a low scanning efficiency. The characteristics of these reactions are in other respects very similar to those observed at lower energies. The K^*'s seem to be produced by natural-parity exchange. (auth)

11674 MEASUREMENT OF π^-P ELASTIC SCATTERING AT 14.15 GEV/C. Dzierba, A. R.; Ford, W. T.; Gomez, R.; Oddone, P. J.; Peck, C. W.; (and others) (California Institute of Technology, Pasadena, California 91109). Phys. Rev. D 7: No. 3, 725-729 (1 Feb 1973).

Results are presented of a wire-spark-chamber spectrometer measurement of the differential cross section for π^-p elastic scattering at 14.15 GeV/c. The region covered in the square of the four-momentum transfer, t, is $0.01 < -t < 0.78$ (GeV/c)^2. The cross section is found to obey very nearly a simple exponential t dependence with no evidence of structure. A fit to the data of the form $d\sigma/dt \propto \exp(bt + ct^2)$ on the range $0.05 < -t < 0.78$ (GeV/c)^2 (i.e., above the region affected by Coulomb scattering) yields $b = 8.26 \pm 0.10$ (GeV/c)^2 and $c = 1.01 \pm 0.17$ (GeV/c)$^{-4}$. Considering the results of previous measurements, $b \simeq 11$ (GeV/c)$^{-2}$ for $-t < 0.05$ (GeV/c)^2, a deviation from the simple exponential near $-t \simeq 0.05$ (GeV/c)^2 is indicated. (auth)

11675 $K^-\pi^-$ ELASTIC SCATTERING CROSS SECTION MEASURED IN 14.3 GeV/c K^-p INTERACTIONS. Linglin, D. (Ecole Polytechnique, Paris); Chaurand, B.; Drevillon, B.; Labrosse, G.; Lestienne, R.; Salmeron, R. A.; Miller, R. J.; Paler, K.; Phelan, J. J.; Shah, T. P.; Barloutaud, R.; Borg, A.; Louedec, C.; Pierre, F.; Spiro, M. Nucl. Phys.; B57: No. 1, 64-76 (1973).

Results are presented on a measurement of the $I = 3/2$ $K\pi$ elastic scattering cross section by applying the Chew-Low extrapolation method in the reaction $K^-p \to K^-\pi^-\Delta^{++}$ at 14.3 GeV/c. The magnitude of $\sigma(K^-\pi^- \to K^-\pi^-)$ is found to be about 3 mb at threshold and slowly falling with energy to about 1.5 mb at 2.8 GeV. The off-mass-shell moments of the differential elastic cross section are given. The absolute value of δ_3^0 is found to be increasing slowly from 0° to 20° between threshold and 1.2 GeV. (auth)

11676 PHOTOPRODUCTION OF π^+ MESONS ON POLARIZED PROTONS AT PHOTON ENERGIES BETWEEN 0.5 AND 2.2 GeV. Althoff, K. H.; Feller, P.; Herr, H.; Hoffmann, W.; Kadansky, V.; Menze, D.; Opara, U.; Schittko, F. J.; Schulz, W.; Schwille, W. J. (Univ., Bonn). Nucl. Phys.; B53: No. 1, 9-18 (1973).

The target asymmetry $T = (\sigma\uparrow - \sigma\downarrow)/(\sigma\uparrow + \sigma\downarrow)$ for the reaction $\gamma p \to \pi^+n$ was measured at the Bonn 2.5 GeV electron synchrotron for a pion c.m. angle of 40° and γ energies between 0.5 and 2.2 GeV. Butanol was used as the target material. About 35% of the protons could be polarized using the dynamic-polarization method in a continuous-flow cryostat operating at 1°K and 25 kG. The π^+ mesons were detected in a magnetic-spectrometer system. Considerable structure in the asymmetry was observed. (auth)

11677 SIX-PRONG EVENTS PRODUCED IN 5 GeV/c π-p INTERACTIONS. Berlin-Dubna Collaboration. Nucl. Phys.; B53: No. 1, 43-61 (1973).

Results are presented from a study of 3 184 six-prong π^-p interactions at 5 GeV/c in the Dubna 1 m hydrogen bubble chamber. Cross sections for the various reaction channels are given and their energy dependence is discussed. The emphasis is on exhibiting the semi-inclusive particle spectra in sufficient detail so that it will be possible to use it for testing models and developing new concepts. In particular, invariant distributions are plotted against the scaled longitudinal momentum x, the rapidity y and the longitudinal momentum p_L in the lab system. The net charge per x as well as y interval is also presented. It is found that the isotropic pion component is inconsistent with the Bose-Einstein formula. Comparison with data at other energies is made whenever possible. (auth)

11678 ANALYSIS OF HIGH-ENERGY BACKWARD πN SCATTERING. Storrow, J. K.; Winbow, G. A. (Daresbury Nuclear Physics Lab., Eng.). Nucl. Phys.; B53: No. 1, 62-90(1973).

The current data on backward πN scattering cross sections and elastic polarizations are analyzed. It is shown that the conventional Regge-pole model with N_α, Δ_δ and N_γ trajectories cannot fit the polarization data, and it is argued that none of the conventional cut models can do so either. However a pole model with a double zero in N_α exchange at $\alpha N_\alpha = -1/2$ cannot quite be ruled out at present. We also consider a picture in which $I = 1/2$ exchange is then determined to be very far from a simple Δ_δ pole. There is only slight evidence for a "geometrical zero" in the spin-no-flip $I = 3/2$ amplitude and no evidence exists for or against such a zero in the spin-flip $I = 3/2$ amplitude. Systematic errors in the data are also discussed and future experiments are suggested. (auth)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 11634.

General

Refer also to abstract 12026.

11679 (COO-3130-TA-280) CLUSTERINGS IN HADRONIC PRODUCTION AND MARKOVIAN WALK. Tan, C. I. (Brown Univ., Providence, R. I. Dept. of Physics). [nd]. Contract AT(11-1)-3130. 15p. (CONF-730334-4). Dep. NTIS $3.00.

From 8th Recontre de Moriond conference: Meribel-les Allues, France (4 Mar 1973).

The approach to the scaling limit of the inclusive cross sections in the central region is correlated with the local clustering effect in the rapidity distribution. An explicit model is constructed where the scaling limit can be approached from below. This is then explained from the point of view of Markovian walk in one-dimension. (auth)

11680 (COO-3533-22) RESEARCH PROGRAM IN ELEMENTARY PARTICLE THEORY. Progress Report for the Period Ending August 31, 1973. (Syracuse Univ., N. Y.). 1973. Contract AT(11-1)-3533. 39p. (SU-4205-22). Dep. NTIS $4.00.

Theoretical research on elementary particles is summarized. A list of publications is included. (JFP)

11681 (JINR-P2-7120) MUTUAL COHERENCE OF INCOHERENTLY GENERATED MESONS. Kopylov, G. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 12p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The well-known GGLP-effect can be expressed in terms of the mutual coherence function (MCF) of like mesons $\tilde{B}(\vec{r}_1, \epsilon_1, \vec{r}_2, \epsilon_2)$ where ϵ_1, ϵ_2 are the meson energies; $\vec{p}_1$, $\vec{p}_2$ are momenta; $\vec{r}_1$, $\vec{r}_2$ are the coordinates of meson counters. Some properties of the MCF for like hadrons are demonstrated. The differential equation for the MCF is derived. The MCF is propagating as a wave (as an amplitude) but its modulus can be measured directly. The exact solution of the equation is obtained as well as its approximate form for macroscopic distances R_0 from the target. The notions of the coherence angle, that coincides with that measured in the GGLP-effect, and coherence length for like hadrons are introduced. The hadron analog of the optical theorem of Van Cittart-Zernioke is proved. (auth)

11682 MACHINE RECOGNITION OF PATTERNS IN PARTICLE PHYSICS. Zanella, P. (European Organization for Nuclear Research, Geneva). Comput. Phys. Commun., Suppl.; 3: 63-74(Sep 1972).

In the last decade, computerized data handling techniques have changed the experimental habits of nuclear physics. The important role of digital pattern recognition methods is underlined. The machine recognition and classification problems encountered in particle physics are reviewed and compared with those typical of other fields. Practical achievements are emphasized and an attempt is made to analyze them as part of that body of knowledge collected under the headings of "pattern recognition". Some state-of-the-art projects and outstanding problems are mentioned together with considerations of possible future developments. (auth)

11683 ALGEBRAIC TECHNIQUES. Veltman, M. (Univ., Utrecht). Comput. Phys. Commun., Suppl.; 3: 75-78(Sep 1972).

The achievements in the field of computer programs that can perform algebraic manipulations are reviewed. The computation of the f and g series in celestial mechanics and the application of algebraic techniques in elementary particle physics are discussed. (JFP)

11684 PROGRAM OF UNIFIED THEORY. Ivanenko, D. (Moscow State Univ.). Tensor; 25: 161-170(1972).

The inclusion of gravitation-cosmology in a unified picture of physical reality is discussed. Nonlinear spinor theory with quarks, gravidynamics, and cosmology and elementary particles are treated. (JFP)

11685 PARTICLE MULTIPLICITY DISTRIBUTIONS AT HIGH ENERGY. Ter-Martirosyan, K. A. (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett.; 44B: No. 4, 377-380(14 May 1973).

It is shown that the high energy Regge cut contribution theory based on the reggeon graph scheme can be used to calculate the shape of particle multiplicity distributions and to obtain a number of different partial cross sections. (L.B.S.)

11686 INCLUSIVE PROCESSES AND DUALITY. Kaidalov, A. B.; Kondratyuk, L. A. (Inst. for Theoretical and Experimental Physics, Moscow). Nucl. Phys.; B57: No. 1, 100-108(1973).

The criteria of a fast approach to the asymptotic limit for the cross section of the inclusive reaction $a + b \to c + X$ are discussed. It is argued that in the fragmentation and central regions ($x < 0.5$) there are in general no reasons for fast scaling even if all the $ab\bar{c}$, $a\bar{c}$ and ab channels are exotic. In the region of x near 1 ($x > 0.5$) the criterion of Chan et al. (i.e., exotic quantum numbers in the $ab\bar{c}$ channel) is sufficient to have fast scaling. The conclusions are in agreement with experimental data. Analyzing the triple-Regge limit relations between three-reggeon vertices are also derived. These relations are of two types and follow from the application of duality to the resonance component of the produced X-system $a + b \to c + X_R$ and to the reggeon-particle scattering amplitude. (auth)

Electromagnetic

Refer also to abstract 11805.

11687 (DESY-73/9) ELECTROPRODUCTION OF PIONS WITH POLARIZED BEAMS AND POLARIZED TARGETS. Bartl, A.; Majerotto, W. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar 1973. 29p. Dep. NTIS (U. S. Sales Only) $3.50.

A general analysis of single pion electroproduction with polarized leptons and polarized target but undetected final state polarizations is presented. Suitable asymmetries for cross section measurements are defined. A discussion of π^+n production at high energies is given, and predictions are made on the basis of a Born term model and a Regge model extrapolated from photoproduction. (auth)

11688 (FRNC-TH-307) DETERMINATION OF ELECTRON ENERGIES IN HEAVY LIQUID BUBBLE CHAMBERS USING A MONTE CARLO METHOD. Van Quaethem, P. (Paris Univ. (France)). 1972. 93p. (In French). NTIS (U. S. Sales Only). Thesis.

Problems associated with estimating the energies (and the corresponding errors) of electrons materialized in heavy liquid bubble chambers were studied using a Monte-Carlo method to simulate bremsstrahlung phenomena with a group of electrons having known energies. The choice of parameters was influenced by the disymmetrical shape of the distributions produced by such phenomena. The results were checked in the $\pi^+p \to \pi^+p^+(n\pi^0)$ $n< = 3$ experiment. The distributions obtained demonstrate that no significant réductions in the errors compared to those encountered with the Behr-Mittner method were achieved, although the formulas expressed in terms of the lengths are more justified. The improvements realized in estimating the initial energies are significant. (FR)

11689 ELECTROMAGNETIC ρ-ϕ MIXING. Renard, Y. (USTL, Montpellier, France). Phys. Lett., 44B: No. 3, 289-292(30 Apr 1973).

The evaluation of the ρ-ϕ mixing parameter is discussed. Applications to the $\phi \to 2\pi$ decay and to the reaction $e^+e^- \to 2\pi$ are given. (auth)

11690 HOW BIG ARE ANOMALOUS DIMENSIONS. Farrar, G. R. (Inst. for Advanced Study, Princeton, NJ). Phys. Lett., 44B: No. 3, 275-277(30 Apr 1973).

The anomalous dimension of the isovector tensor operator analogous to the energy-momentum tensor is estimated using measured deep-inelastic structure functions and the known value of the proton-neutron mass difference. It is found to be about 0.04 or smaller. (auth)

11691 PION ELECTROPRODUCTION ON NUCLEONS IN THE CURRENT ALGEBRA MODEL WITH HARD PIONS. Radutskii, G. M.; Serdyutskii, V. A. (Tomsk Polytechnic Inst., USSR). Yadern. Fiz.; 17: No. 5, 1034-1044(May 1973). (In Russian).

Pion electroproduction on nucleons at low energies is considered in the framework of the current algebra with hard pions. The reaction amplitude is calculated with the effective Lagrangian used in the tree approximation. The differential cross sections and multipole amplitudes agree with the experimental data at the energies of the pion-nucleon system up to the $\Delta(1236)$ resonance. (auth)

11692 ELECTRON AND THE MUON AS EIGENSOLUTIONS OF QUANTUM ELECTROMECHANICS UNDER THE GREEN-FUNCTION $\Delta(x^2 + l^2)$. Bopp, F.; Lutzenberger, W. (Univ., Munich). Z. Naturforsch.; 28a: No. 3-4, 408-416(1973).

Replacing the Green function of Maxwell's electrodynamics $\Delta(x^2)$ by $\Delta(x^2 + l^2)$ one obtains a Hamiltonian with a finite number of degrees of freedom for the classical motion of a point charge in its own electromagnetic field. After quantization one obtains a mass spectrum if one assumes that a nonelectrodynamic bare mass M exists. The spectral terms are $S_{½}$, $P_{½}$; $P_{⅜}$, $D_{½}$; $D_{⅝}$ etc. It is possible to fit the length l in the Green function and the mass M so that the mass ratio of the lowest terms becomes $m(P_{½})/m(S_{½}) = m(\mu)/m(e)$. One then gets: $l = 4.896 \times 10^{-91}\ h/2\pi cm(p)$ $M = 15.32\ m(p)$. Hence the deviation from Maxwell's electrodynamics is extremely small, but not zero, and heavy leptons should exist near m = M. Some further leptonic states exist with masses similar to that of the muon. All states, those of the electron and the muon excepted, are γ-unstable (lifetime 10^{-17} sec. resp. 10^{-26} sec). (orig.). (GF)

11693 FOURTH-ORDER CHARGE RADIUS OF THE MUON AND ITS CONTRIBUTION TO THE LAMB SHIFT. Barbieri, R. (Scuola Normale Superiore, Pisa, Italy); Caffo, M.; Remiddi, E. Lett. Nuovo Cim.; 7: No. 2, 60-62(12 May 1973).

The difference $b_\mu - b_e$ between the dimensionless slopes b_μ, b_e of the charge form factor of the muon and of the electron at fourth order in the electric charge is evaluated analytically. The difference $a_\mu - a_e$ of the muon and electron anomalies at fourth order is also evaluated. The slope contribution to the $2S_{½}$-level shift of muonic hydrogen is obtained. (LBS)

11694 DOUBLE BREMSSTRAHLUNG. Smirnov, A. I. (Kostroma State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 159-160(1973). (In Russian).

The reaction generating double bremsstrahlung has the form $e^- + (Ze) \rightarrow (Ze) + e^- + \gamma + \gamma$. The differential cross section of this reaction was derived with the use of a Feynman diagram, making allowance for the case of interference and polarization of the particle. (KSW)

11695 DOUBLE COMPTON EFFECT. Smirnov, A. I. (Kostroma State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 158-159(1973). (In Russian).

The double Compton effect consists of photon scattering by an electron with the generation of an additional photon: $\gamma_1 + e_2^- \rightarrow e_2^- + \gamma_2 + \gamma_3$. The differential cross section for this reaction was calculated for the case of interference averaged for polarization of the particle. (KSW)

11696 PHOTON-HADRON INTERACTIONS. Feynman, R. P. Frontiers in Physics. Reading, MA; W. A. Benjamin, Inc. (1972). 296p. $7.95.

Lectures on the theory of photon-hadron interactions cover the following topics: general theoretical background; low-energy photon reactions; quark model of resonances; high-energy pseudoscalar meson photoproduction; t-channel exchange phenomena; vector mesons and vector meson dominance hypothesis; electromagnetic form factors; electron-proton scattering in the deep inelastic region; parton model; light cone algebra; properties of commutators in momentum space; electromagnetic self energy; other two-current effects; hadron-hadron collisions at extreme energies; final hadronic states in deep inelastic scattering; and partons as quarks. (LBS)

11697 INDUCED SYNCHROTRON RADIATION OF AN ELECTRON MOVING THROUGH A MEDIUM. Kul'kin, A. G.; Pavlenko, Yu. G. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 1, 18-32(1973). (In Russian).

Forced radiation and the absorption of electromagnetic waves by an electron was investigated by the methods of quantum electrodynamics. The electron was assumed to be in motion along a helical path through a medium. Expressions were obtained for the intensity of the radiation for the chief components of polarization. (tr-auth)

11698 RADIATIVE CAPTURE OF A μ^+ MESON BY AN ELECTRON IN THE FIELD OF AN ELECTROMAGNETIC WAVE. Grats, Yu. V.; Pavlenko, Yu. G. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 1, 77-80(1973). (In Russian).

It is shown that the process of induced $\mu - e$ annihilation proceeds with the predominant absorption of energy of an electromagnetic field. The angular dependence of the absorbed power was investigated in the case of the nonrelativistic energy of the $\mu - e$ pair. (tr-auth)

11699 QUASICLASSICAL SOLUTIONS OF THE DIRAC EQUATION AND THE EMISSION OF PHOTONS IN A STATIC ELECTROMAGNETIC FIELD. Zhukhovskii, V. Ch.; Nikitina, N. S. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 1, 94-101(1973). (In Russian).

A unique expression for the probability of radiation in constant electric and magnetic fields was derived from quasiclassical solutions of the Dirac equation. The polarization properties of the radiation were examined. It was shown that in an electric field an electron spin under the influence of radiation is oriented chiefly perpendicularly to the field. (tr-auth)

11700 INFORMATION PROPERTIES OF A NEUTRAL PARTICLE OF SPIN ½h. Khiralla, N. F. (Tbilisi State Univ., USSR). Soobshch. Akad. Nauk Gruz. SSR; 70: No. 2, 305-308(May 1973). (In Russian).

On the basis of Majernik's general model, a connection was established between the information properties and the physical characteristics of a quantum object state. A formula is given to calculate the information content when a neutral particle of spin ½ h passes from one state to another in a uniform magnetic field, which is constant in absolute magnitude and whose direction rotates uniformly with angular velocity ω. (auth)

11701 HIGH ENERGY SCATTERING AND THE EXTENDED HADRONIC STRUCTURE OF THE PHOTON. Bauer, T. H. (Daresbury Nuclear Physics Lab., Eng.). Nucl. Phys.; B57: No. 1, 109-138(1973).

Dealing with high-energy photons incident on nucleon targets at rest, a theory is developed describing the role of the photon's most extended hadronic structure in diffractive reactions such as ρ^0 photoproduction and Compton scattering. Both real and virtual photons are considered, and emphasis is placed on the general role of compositeness in scattering. The work is compared and contrasted with conventional t-channel and naive vector-meson dominance points of view. (auth)

11702 AMPLITUDE CONSTRAINTS IN π^0 PHOTOPRODUCTION. Goldstein, G. R.; Owens, J. F.; Rutherfoord, J. P. (Tufts Univ., Medford, MA). Nucl. Phys.; B57: No. 1, 18-24(1973).

Recent data on neutral-pion photoproduction in the dip region is near the limit of a constraint equation. It is shown that the limit implies a simplified view of the helicity amplitudes. Within the framework of the dual absorption model the qualitative shape of the amplitudes is estimated and it is found that the observed structure differs from that predicted in current models of π^0 photoproduction. (auth)

11703 POLARIZATION PREDICTIONS FOR K^+ PHOTOPRODUCTION. Goldstein, G. R.; Owens, J. F. III; Rutherfoord, J. (Tufts Univ., Medford, MA). Nucl. Phys.; B53: No. 1, 197-216(1973).

Using the existing data for charged pion photoproduction, some general features of the observables in K^+ photoproduction are obtained. Using the constraints imposed by duality allows further predictions to be made. Two versions of the Reggeized absorption model are presented and comparison is made with earlier models. (auth)

Weak

Refer also to abstract 11692.

11704 LEPTONIC PRODUCTION OF SCALAR W-MESON AT SUPER-HIGH ENERGIES. Pyzh, V. M. (Kharkov State Univ.). Yadern. Fiz.; 17: No. 5, 1063-1069(May 1973). (In Russian).

The expressions are obtained for the differential cross sections of the reactions $\nu + Z \rightarrow Z + \mu^- + W_0^+$ and $\mu^- + Z \rightarrow Z + \nu + W_0^-$ in the $\mu^2/m_0^2 \ll 1$ approximation (μ and m_0 are respectively the muon and W_0-meson masses), the integration over the final lepton and W_0-meson momenta being carried out. The asymptotic expansion of the total cross sections of the above mentioned reactions on the proton target is given. All the logarithmic terms and the constant are kept in the expansion. (auth)

11705 CROSS SECTIONS OF DEEP INELASTIC PROCESSES $\nu + p \rightarrow \nu + l^+ + l^-$ + HADRONS. Bugaev, E. V.; Gurenstov, V. I.; Domogatskii, G. V.; Zheleznykh, I. M. (Inst. of Nuclear Research, Moscow). Yadern. Fiz.; 17: No. 5, 1070-1074(May 1973). (In Russian).

The cross sections of charged leptonic pair production in neutrino-proton interaction accompanied by excitation of the proton is calculated. The electromagnetic structure functions of the proton obtained from the experimental data and the scaling invariance

assumption are used in the calculation. The cross section of the considered processes at the neutrino energies $E_\nu \lesssim 50$ to 1000 GeV appears to be 10 to 20% of the cross section of corresponding "elastic" processes. (auth)

11706 WEAK INTERACTIONS. Commins, E. D. McGraw-Hill Advanced Physics Monograph Series. New York; McGraw-Hill Book Company (1973). 388p. $18.50.

The most important basic material on weak interactions is presented. Discussions include such topics as muon decay, muonium, neutrino–lepton interactions, pion decay, implications of parity, charge conjugation and time reversal for weak interactions, the conserved vector-current hypothesis, the partially conserved axial-current hypothesis, nuclear beta decay, muon capture, SU(3) and weak interactions, semileptonic and nonleptonic decays of hyperons, weak interactions of K mesons, CP violation, parity violation in nuclear forces, neutrino–nucleon interactions, and neutrino astrophysics. A general bibliography is provided, in addition to selected references at the end of each chapter. (LBS)

11707 LOWER BOUND ON THE MAGNITUDE OF THE RATE OF $K^+ \to \pi^+ + e^+ + e^-$. Segrè, Gino; Wilkinson, David (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). Phys. Rev. D 7: No. 3, 804-809 (1 Feb 1973).

It is shown that a lower bound on the decay rate $K^+ \to \pi^+ e^+ + e^-$ can be obtained by calculation of the absorptive part of the amplitude to which only the connected three-pion intermediate state contributes significantly. Some remarks on pole-model calculations are also included. (auth)

11708 ANOMALOUS INTERACTION OF MUONS AND MUONIC ATOMS. Okun, L. B.; Zakharov, V. I. (Inst. for Theoretical and Experimental Physics, Moscow). Nucl. Phys.; B57: No. 1, 252-262(1973).

Restrictions for the constants of possible anomalous interactions of muons with nucleons which follow from available muonic-atom data are obtained. The possible contribution of anomalous interactions to (a) difference between radii of nuclei obtained from the data on muonic atoms and from electron scattering, (b) fine and (c) hyperfine splitting of muonic-atom levels, is discussed. (auth)

Strong (General)

11709 (COO-3130-TA-279) HADRONIC SCATTERING AT SMALL AND LARGE MOMENTUM TRANSFERS. Fried, H. M. (Brown Univ., Providence, R. I. Dept. of Physics). 1973. 8p. (CONF-730334-1). Dep. NTIS $3.00.

From 8th Recontre de Moriond conference: Meribel-les Allues, France (4 Mar 1973).

The nature of possible corrections to the Cheng-Wu forward-direction amplitude is examined on the basis of a complete eikonal formulation, which suggests strong cancellations away from the Froissart bound, $\sigma_T \sim \ln^2 s$. Two models of wide-angle scattering, the interchange model and the hadronic bremsstrahlung model, are briefly discussed and compared. (auth)

11710 (IPNO-TH-73-3) CUTS IN THE ANGULAR-MOMENTUM PLANE AND INCLUSIVE-TYPE SUM RULES. Kang, K.; Moore, R. W.; Nicolescu, B. (Paris Univ., Orsay (France). Institut de Physique Nucleaire). Feb 1973. 9p. Dep. NTIS (U.S. Sales Only) $3.00.

Explicit forms for the two-reggeon cut in particle-particle scattering are derived from the sum rule for inclusive-type discontinuities in the kinematic region near the phase-space boundary. When the dual resonance model is used as a representation for the six point amplitude, the detailed results are in agreement with those of Abarbanel. (FR)

11711 (JINR-E2-7122) DUAL MODELS IN FORMALISM OF RANDOM PROCESSES. Mal'tsev, V. M.; Dushutin, N. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 7p. Dep. NTIS (U.S. Sales Only) $3.00.

If multiple production of hadrons is thought of as a random process, then the n particle exclusive reaction probability can be obtained in the same form as it follows from the dual resonance model. (auth)

11712 (JINR-P2-7090) HADRON INTERACTION MODELS OF HIGH MULTIPLICITY. Dushutin, N. K.; Mal'tsev, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 11p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

From the analysis of the Feynman-gas kinetic equations a new class of the hadron interaction models of high multiplicity of secondary particles is obtained. The models have scaling and correlation parameters, which are in agreement with experiment. (auth)

11713 (RL-73-29) STATISTICAL BOOTSTRAP OF NON-SPHERICAL FIREBALLS. Montvay, I. (Rutherford High Energy Lab., Chilton (England)). May 1973. 21p. Dep. NTIS (U.S. Sales Only) $3.25.

The integral equations determining the hadron distribution emerging from a fireball are modified to allow a non-spherical shape. A specific model with built-in transversal cut-off is investigated in more detail and the connection with other statistical models is shortly discussed. (UK)

11714 NO-GHOST THEOREM FOR THE POMERON SECTOR OF THE DUAL MODEL. Olive, D.; Scherk, J. (CERN, Geneva). Phys. Lett., 44B: No. 3, 296-300(30 Apr 1973).

The Pomeron sector of the dual model comprises a spectrum of states obtained by factorizing the residues of poles occurring in a certain channel (with vacuum quantum numbers) of the orientable non-planar single loop graphs of the conventional dual model considered in 26 space-time dimensions. It is shown that the spectrum of Pomeron states which couple between external physical particle states is transverse and hence positive definite and thus ghost-free. The same states also factorize the Virasoro-Shapiro model which now appears very likely to be the scattering theory of Pomeron ground states. (auth)

11715 QUARKS IN DUAL MODELS. Dyatlov, I. T. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 17: No. 5, 1079-1083(May 1973). (In Russian).

A method in which the non zero triality particles cannot be made free is proposed to construct quark models in dual theory. (auth)

11716 HADRON STRUCTURE EXPLORED IN HIGH-ENERGY NUCLEAR REACTIONS. Goldhaber, Alfred S. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, Long Island, New York 11790). Phys. Rev. D 7: No. 3, 765-772 (1 Feb 1973).

Current data indicate that fast "excited hadrons," produced in high-energy collisions with nuclei, interact with the nuclear medium no more strongly than stable hadrons of the same internal quantum numbers. Considerations on the time development of excited hadron systems suggest that, in coherent nuclear production at any finite energy, the (indirectly) measured cross section of an excited hadron on a nucleon differs negligibly from its value immediately after production. Significant further information should be obtained from deep-inelastic lepton-nucleus collisions, but the results already found are most easily interpreted by supposing hadrons to be constructed from small or pointlike units, each of definite cross section, which do not have time to change in number during passage of a fast hadron through a nucleus. (auth)

11717 LINEAR REGGE TRAJECTORIES AND HADRONIC LEVEL DEGENERACY AT HIGH ENERGIES. Satz, H. (CERN, Geneva). Phys. Lett.; 44B: No. 4, 373-376(14 May 1973).

The statistical bootstrap condition for hadronic systems at rest implies an asymptotic density of states increasing exponentially in the total energy. It is shown that if for a given system the squared energies of all possible subsystems are constrained to lie on linear Regge trajectories, such a behavior of the level density indeed follows. This result is then used to clarify common features of dual and statistical bootstrap approaches. (auth)

11718 CORRELATIONS OF IDENTICAL PIONS IN MULTI-BODY PRODUCTION. Shuryak, E. V. (Inst. of Nuclear Physics, Novosibirsk, UR). Phys. Lett.; 44B: No. 4, 387-389(14 May 1973).

The identical quanta correlations give information on the spatial and time structure of the production reactions. Their dependence on the multiplicity and average particle energy is estimated and compared with available data. (auth)

11719 TOWARD A GENERAL DESCRIPTION OF TWO-BODY HADRON REACTIONS. Hartley, B. J. (Laboratoire de Physique Theorique et Particules Elementaires, Orsay, France); Kane, G. L. Nucl. Phys.; B57: No. 1, 157-211(1973).

A model is presented for describing two-body high-energy hadron reactions at energies above the resonance region. Although no real theory yet exists, a procedure can be given for obtaining a (possibly correct) description of the amplitudes for any two-body reaction (whatever the spins involved, including real and imaginary parts of amplitudes, any helicity-flip π-exchange as well as vector and tensor exchanges, etc.). The most important new physical effect involved is using the appropriate t-dependent phase for the vacuum exchange amplitude (the pomeron), both in elastic scattering and in describing absorption effects. The pomeron is not a Regge pole. The model is very simple to formulate and has a reasonable physical interpretation in terms of important unitarity effects and absorption. It allows us to understand the partial successes and the inadequacies of previous approaches such as the

dual absorptive model, the strong absorption model, the view that some amplitudes have Regge-pole behavior while others do not, etc. All the $0^-\frac{1}{2}^+ \to 0^-\frac{1}{2}^+$ reactions, $np \to pn$, and $\bar{p}p \to \bar{n}n$, cross sections, polarizations and amplitudes are analyzed; these include all the important kinds of helicity amplitudes for any two-body reactions. Apart from a few places the results are very good; it is argued that the few places where there may be some difficulty are due to effects left out rather than to the structure of the model. Although the input reggeon exchanges are not all exchange degenerate, the phases of the output amplitudes after absorption show a remarkable and unexpected resemblance to what one would expect from exchange degenerate poles, apart from the necessity of having a zero structure related to important absorption corrections. A number of related results, some of which are considered puzzles, are discussed (total cross-section differences for πN and KN, the increase in $\sigma_T(K^+p)$, crossovers, shrinkage, real parts of elastic amplitudes, polarization single and double zeros, line reversed reactions, pp scattering at the ISR, etc.) and some predictions are given. (auth)

11720 DYNAMICAL MODEL OF BARYONS WITH THE SPINOR–SCALAR BETHE–SALPETER EQUATION. Ladanyi, K. (Roland Eoetvoes Univ., Budapest). Nucl. Phys.; B57: No. 1, 221-251(1973).

The first part of the paper contains a systematic study of the spinor-scalar Bethe–Salpeter equation with a scalar ladder-like interaction. By expansion and truncation procedures a finite system of linear homogeneous equations is obtained which represent the Bethe–Salpeter equation in the space of convenient basis functions. In the second part a relativistic parton model of baryons is suggested. The three-point Bethe–Salpeter amplitude of the bound state baryon is approximated by a decomposition which involves the solutions of a generalized spinor-scalar Bethe–Salpeter equation. These solutions might be interpreted as the single-parton amplitudes. It is assumed that the long-range effective interaction has a Coulomb-type asymptotic behavior. A linear leading Regge trajectory is achieved by assuming that the effective mass of partons is a particular function of the c.m. energy of the baryon. (auth)

11721 SHAPES, MODEL DEPENDENCE AND ENERGY DEPENDENCE OF INCLUSIVE TWO-PARTICLE CORRELATIONS TREATED IN THE FRAMEWORK OF THE THERMODYNAMIC MODEL. Ranft, J. (Karl-Marx-Univ., Leipzig); Ranft, G. Nucl. Phys.; B53: No. 1, 217-250(1973).

Based on the thermodynamic model for particle production, inclusive two-particle correlations are studied. The model is used to study integrated correlations $R^{(2)}(s)$ and rapidity correlations at accelerator and ISR energies. Particle production is described via the formation of clusters called fireballs. The average mass of these clusters changes as $s^w \exp(-|\eta|v)$, $(0 \le v, w \le 1)$ with the primary energy s and fireball rapidity η. The model produces in the limiting cases the same correlations as the multiperipheral model (with $w = 0$) and the diffractive excitation model (with $w = 1$) but contains also all intermediate cases $(0 < w < 1)$ in which fireballs increasing in mass and number are formed. The average number of fireballs produced is also calculated. At ISR energies integrated correlations $R^{(2)}$ and rapidity correlations are very different in the cases $w = 0$, $\frac{1}{2}$ and 1. Therefore, experimental data at high energy on $R^{(2)}(s)$ or on rapidity correlations will allow one to determine the parameter w. Measurements of these different quantities should result in a consistent picture for the production of fireballs. (auth)

Strong (Baryon No. = 0)

11722 TEST OF DUALITY IN BARYON–ANTIBARYON AMPLITUDES FROM REGGEON – PARTICLE SCATTERING. Hoyer, P. (Oxford Univ.); Roberts, R. G.; Roy, D. P. Phys. Lett.; 44B: No. 3, 258-262(30 Apr 1973).

By studying the backward production data for meson resonances the dual properties of baryon-Reggeised antibaryon elastic scattering were investigated. Strong support was found for the duality prediction that meson resonances in the baryon antibaryon channel should be dual to an exotic trajectory. (auth)

11723 CONSTITUENT QUARKS, CURRENT QUARKS, AND PIONIC DECAYS OF RESONANCES. Hey, A. J. G.; Weyers, J. (CERN, Geneva). Phys. Lett.; 44B: No. 3, 263-265(30 Apr 1973).

Predictions for pionic decays of meson and baryon resonances are derived from PCAC and the algebraic properties of the (Melosh) transformation between constituent and current quarks. (auth)

11724 γ-SPECTRUM PRODUCED FROM THE ANNIHILATION OF STOPPED $\bar{p}$ IN HYDROGEN. Dal'karov, O. D.; Samonlov, V. M.; Shapiro, I. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 5, 1084-1089(May 1973). (In Russian).

The probabilities are calculated of radiative transitions from the 1S-state of the $p\bar{p}$ atom to the nucleon–antinucleon bound nuclear-like state. It is shown that the γ-spectrum from the $\bar{p}$-capture in hydrogen in the 0 to 600 MeV energy range must consist of several lines having the widths of 10 to 50 MeV and intensities of 10^{-2} to 10^{-3} of the total annihilation probability. (auth)

11725 SPIN EFFECTS IN QUASINUCLEAR MESON PRODUCTION VIA POLE MECHANISM. Ots, I. (Inst. of Physics and Astronomy, Tartu). Yadern. Fiz.; 17: No. 5, 1075-1078(May 1973). (In Russian).

The spin relations in the reactions of quasinuclear meson production are investigated when the reaction amplitude is dominated by the pole diagram. A possibility to use the polarization relations for determination of the quantum numbers of quasinuclear mesons is considered. (auth)

11726 INTERACTION OF SLOW ANTINUCLEONS WITH NUCLEONS AND NUCLEI. Shapiro, I. S. (Inst. of Theoretical and Experimental Physics, Moscow). Usp. Fiz. Nauk; 109: No. 3, 431-454(Mar 1973). (In Russian).

This review is concerned with collisions of nonrelativistic antinucleons ($\bar{N}$) with nucleons (N), where the limitation of low energies permits a potential approach to an $N\bar{N}$ interaction, notwithstanding annihilation. The potentials of NN and $N\bar{N}$ interactions, annihilation, and problems of the bound and resonance states of $N\bar{N}$ are discussed. Considerable attention is given to quasinuclear states and quasinuclear mesons with Regge trajectories, and the generation of quasinuclear mesons with beams of slow antinucleons. 40 references. (KSW)

11727 SOFT-PION LIMITS OF THE INCLUSIVE PION DISTRIBUTIONS IN $\bar{N}N \to \pi^\pm$ + ANYTHING AT REST. Orfanidis, S. J.; Rittenberg, V. (Rockefeller Univ., New York). Contract AT(11-1)-2232. Nucl. Phys.; B56: No. 2, 561-564 (1973).

The PCAC hypothesis of extrapolating off mass shell is used to show that the invariant pion distributions in the reactions $\bar{N}N \to \pi^\pm$ + anything at rest must vanish as the pion momentum tends to zero, a behavior which is supported by recent data on $\bar{p}n \to \pi^\pm$ + anything. (auth)

11728 UPPER LIMIT FOR THE FORWARD AND BACKWARD SCATTERING CROSS SECTION IN THE REGION OF THE DIFFRACTION PEAK. Arushanov, G. G.; Pirmatov, I. I. (Tashkent State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 109-112(1973). (In Russian).

Processes of high energy scattering of hadrons and scattering amplitudes were examined with the aid of standard formulas. Experimental data were plotted relative to the normalized differential cross section $d\sigma/dt|d\sigma/dt|_{t=0}$ for pp- and $p\bar{p}$ scattering, π^+p and π^-p, K^+p and K^-p at different energies as functions of $x_t^2 = R_t^2|t|$. (KSW)

11729 NONLINEAR QUARK THEORY OF SPIN s = 2 (GRAVIMESONS) FIELD. I. Kurdgelaidze, D. F.; Funke, Kh. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 94-100(1973). (In Russian).

An equation for the meson octet of spin s = 2 (octet of gravimesons) was derived from a nonlinear quark model, allowing for their interaction with mesons s = 0 and s = 1^-. Magnetic moments and decay constants of the gravimeson octet were determined for mesons with s = 0^{-1} and s = 1^-. (tr-auth)

11730 COORDINATE-INDEPENDENT GREEN'S FUNCTIONS FOR THE CHIRAL-INVARIANT PION-MODEL. Meetz, K. (Univ., Bonn). Z. Naturforsch.; 28a: No. 3-4, 386-393(1973).

A coordinate-independent formulation of the chiral-symmetry pion theory is developed using a dreibein field which introduces a redundant gauge field into the field equations. There is a particular gauge, where the field variables transform linearly under chiral transformations and the field equations reduce to those of the Sugawara-model. Quantization of Sugawara's field equations is obtained in terms of Green's functions. The field equations for the coordinate-independent Green's functions are translated into equations for coordinate Green's functions by introduction of the coordinates as auxiliary variables. The latter field equations incorporate the additional Feynman graphs discovered before. (auth)

11731 LINEAR REGGE TRAJECTORIES WITH A LEFT-HAND CUT. Antoniou, N. G. (CERN, Geneva, Switzerland); Georgalas, C. G.; Kouris, C. B. Phys. Rev. D 7: No. 3, 750-755 (1 Feb 1973).

The properties of boson Regge trajectories $\alpha(s)$ with a left-hand cut

for $s<0$ are studied, with the following assumptions: (a) Re α (s) is linear in the physical regions of the s and t channels. (b) The imaginary part is asymptotically smaller than the real part. (c) At $s=0$, α (s) has a branch point due to the existence of a Regge cut α_c(s) in the angular momentum plane, with $\alpha_c(0) = \alpha(0)$. The branch point is attributed to the collision of the physical pole α (s) with a second-sheet pole $\tilde{\alpha}$ (s), at s=0. (d) The function α (s) is analytic in the s plane. Under these assumptions the imaginary part for each boson trajectory is obtained in terms of a parameter A and a parameter-free universal function determined by solving an integral equation numerically. The parameter A is determined by requiring that the first meson of each trajectory have the observed width. The model gives imaginary parts increasing almost linearly with s for large |s|. The widths of the recurrences increase linearly with their mass. The results support exchange degeneracy ρ–f, K^*–K_N, ω–A_2. The imaginary part, for $s<0$, is compared with the phenomenological results of other authors. (auth)

11732 CROSSING SUM RULES AND HIGH ENERGY BOUNDS. II. Grassberger, P. (Univ., Bonn); Schwela, D.; Kuehnelt, H. Nucl. Phys.; B57: No. 1, 317-332(1973).

Upper bounds on energy-averaged cross sections for $\pi\pi$ scattering are derived starting from crossing dispersion sum rules. While in a previous paper bounds on total $\pi\pi$ cross sections were given, without any high-energy assumption, results are now presented for inelastic cross sections, $p\bar{p} \to \pi^+\pi^-$ annihilation, and bounds depending on additional high-energy assumptions. The latter are typically ~25–30 mb for total $\pi\pi$ cross sections in the region between 2 and 10 GeV. (auth)

11733 EXACT REPRESENTATION OF MESON–MESON SCATTERING AMPLITUDES CONSISTENT WITH CURRENT ALGEBRA CONSTRAINTS. Ford, P. (Brandeis Univ., Waltham, MA). Contract AT(11-1)-3230. Nucl. Phys.; B57: No. 1, 25-44(1973).

All four-point Green functions connected to the vector and axial-vector currents by Ward identities are constructed, consistent with the constraints of an arbitrary current algebra. The structure of the four-point functions is separated into one-particle reducible and irreducible parts, without approximations. That is, no single-particle approximation is made, nor is it assumed that the strangeness-changing vector currents are conserved. The result is a representation of the meson-meson scattering amplitude that explicitly satisfies all the constraints of the current algebra. In particular, it satisfies: (i) threshold theorems, (ii) crossing symmetry and (iii) reduction to the usual tree-approximation in the single-particle approximation. Application is made to kaon-pion scattering, obtaining a representation of the scattering amplitude that is suitable for the investigation of the constraints of elastic unitarity. (auth)

11734 $\pi\pi$ TOTAL CROSS SECTION; ITS SCALE AND MASSLESS PION LIMIT. Pennington, M. R.; Rosenzweig, C. (Univ. of California, Berkeley). Nucl. Phys.; B57: No. 1, 305-316(1973).

The question of the scale of the $\pi\pi$ total cross section is considered. A simple intuitive argument for expecting cross sections in the massless chiral world to be finite is given. Assuming the universality of P-f Regge couplings, a simple dispersion theoretic evaluation of the asymptotic $\pi\pi$ total cross section, $\sigma^{\pi\pi}$, is given. Algebraic expression for $\sigma^{\pi\pi}$ is deduced and it is found that its scale is determined by $1/m_\rho^2$ or, equivalently, $1/f_\pi^2$–just as Pagels conjectured. This relation has a smooth, finite limit as m_π tends to zero. Numerically, $\sigma^{\pi\pi} = 17 \pm 4$ mb for physical mass pions and 14 ± 3 mb for massless pions are obtained. (auth)

11735 UNITARITY, CORRELATION FUNCTIONS AND THE POMERON. Dash, J. (Imperial College, London); Parry, G.; Grisaru, M. Nucl. Phys.; B53: No. 1, 91-107(1973).

The logarithmic coefficient of the second-order integrated correlation function C_2(s) is investigated in the ABFST model with and without a high-subenergy tail. The results show that the sign of $C_2/\ln s$ is determined by the inclusion of the high-subenergy tail, and is positive. To obtain $C_2/\ln s$, a bootstrap calculation is performed utilizing a simple off-shell prescription for $\pi\pi$ resonance and $\pi\pi$ Regge vertex functions in a self-consistent way. (auth)

11736 CROSSING SUM RULES AND HIGH-ENERGY BOUNDS. Grassberger, P. (Univ., Bonn); Kuehnelt, H. Nucl. Phys.; B53: No. 1, 125-134(1973).

Exact energy-averaged high-energy bounds for total $\pi\pi$ cross sections are given which do not depend on the d-wave scattering lengths. Instead, the low-energy input is, essentially, the properties of the f^0 meson. The starting points are rigorous sum rules for the physical absorptive parts, following from crossing and analyticity. Except at rather low energies, these bounds are much tighter than the best previous ones. (auth)

Strong (Baryon No. = 1)

11737 (BNL-17846) AMPLITUDE ANALYSES OF HYPERCHARGE EXCHANGE REACTIONS. Field, R. D. (Brookhaven National Lab., Upton, N. Y.). Apr 1973. 37p. (CONF-730319-4). Dep. NTIS $4.00.

From international conference on π-π scattering as associated topics; Tallahassee, Florida, USA (28 Mar 1973).

The determination of the two-body production amplitudes for Y = 1 exchange reactions is discussed. The pseudoscalar production line reversed reactions $K^-n \to \pi^-\Lambda$ and $\pi^-p \to K^0\Lambda$; the vector-meson production reactions $K^-p \to (\omega,\varphi)\Lambda$ and $\pi^-p \to K^{*0}\Lambda$; the reaction $K^-p \to \pi^-Y^{*+}(1385)$; and the photoproduction reaction $\gamma p \to K^+\Lambda$ are examined. Quark model, SU(3), and VDM comparisons are made and the EXD nature of the K^{**} and K^* Regge exchanges explored. In addition the behavior of the unnatural parity Y = 1 exchanges (K, K_B, K_A) is investigated. (auth)

11738 (FRNC-TH-327) STUDY OF THE POSSIBILITY OF A ρ-ω INTERFERENCE IN THE $\pi^-p \to \pi^+\pi^-n$ REACTION AT 2.77 GeV/c. Pierrard, J. (Paris Univ. (France)). 1972. 130p. (In French). NTIS (U.S. Sales Only).

Thesis.

The possibility of an electromagnetic interference between the ρ and ω particles in the $\pi^-p \to \pi^+\pi^-n$ interaction at 2.77 GeV/c was investigated. The formalism of this phenomenon is well explained by the occurrence of an ω^0 particle in the $\pi^+\pi^-$ mass spectrum. This decay of ω^0 into two pions leads to a violation of G parity. The calculations involve eigenstates of the G parity operator. This treatment avoids certain series expansions and renders the formulas more rigorous. The results obtained are compared with available experimental results. The experiments were accurately performed and a large number of events was considered. Nevertheless interference effects were not observed in the overall $\pi^+\pi^-$ mass spectrum; nor in the spectra obtained after different cuts. (France)

11739 (JINR-D2-7180) JOINT DESCRIPTION OF CHARGE DISTRIBUTIONS AND CORRELATIONS BETWEEN NEUTRAL AND CHARGED PARTICLES IN THE π^-p^- AND π^-n-INTERACTIONS AT p = 40 GeV/c. Grishin, V. G.; Jancso, G.; Kuleshov, S. P.; Matveev, V. A.; Sissakian, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. (In Russian and English). Dep. NTIS (U.S. Sales Only) $3.00.

The data obtained with the help of the model proposed earlier by the authors, are compared with the data on π^-p- and π^-n-interaction experiments carried out at Serpukhov on two-meter propane chamber at the negative pion momentum p = 40 GeV/c. (auth)

11740 (RLO-2230-T-4-89) OFF-MASS SHELL PARITY VIOLATING PION–NUCLEON INTERACTION. Henley, E. M.; Keliher, T. E.; Pardee, W. J.; Yu, D. U. L. (Oregon Univ., Eugene. Inst. of Theoretical Science). 1973. 48p. Dep. NTIS $4.50.

In the usual theoretical description of parity violation, off-mass shell effects of the weak pion nucleon interaction are neglected. In the Cabibbo theory, the weak parity-violating pion-nucleon vertex is then proportional to $\sin^2\theta \approx 0.05$ as it arises only from strangeness-changing weak currents. If off-mass shell effects are taken into account, then a vertex proportional to $\cos^2\theta$ is possible. An effective $\cos^2\theta$ pion-nucleon interaction is derived by means of the renormalizable σ-model. An effective dimensionless coupling estimate is obtained which is roughly given by $Gg\,\vec{\tau}\cdot\phi\,\Delta M/M$ if the nucleon is time-like and half off its mass shell by ΔM. Thus neutral, as well as charged weak pion-nucleon couplings of sizable strengths ($\sim 10^{-6}$) are predicted by this model even though no neutral weak currents are invoked.

11741 ρ DOMINANCE AND REGGE COUPLING IN INCLUSIVE REACTIONS. Amann, R. F.; Blackmon, M. L. (Syracuse Univ., NY). Phys. Lett.; 44B: No. 3, 266-270(30 Apr 1973).

The ρ Regge pole residues are calculated under the assumption of ρ dominance of the isovector, even G parity component of inclusive reactions. The calculated residues compare well with total cross section data and allow successful predictions of the charge dependence of pion production in the central region. Serious difficulties are encountered with the assumption of P + f dominance of the isoscalar even G parity component. (auth)

11742 CONTINUOUS MOMENTUM SUM RULES. Babaev, Z. R.; Zamiralov, V. S. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 17: No. 5, 1105-1110(May 1973). (In Russian).

It is proposed to change the continuous-momentum sum rules in such a way as to obtain in the right-hand side the experimentally measurable differential cross sections and polarization. The latter are used to estimate the lower boundary of the cut-off energy in the sum rules and to find the ratio of the residues of independent am-

plitudes in the charge exchange reaction $\pi^- p \rightarrow \pi^0 n$. The results agree with the high energy data. (auth)

11743 PROPERTIES OF PROTON AND PION SPECTRA IN pp- AND πp- INTERACTIONS AT HIGH ENERGIES. Arestov, Yu. I.; Moiseev, A. M.; Ter-Martirosyan, K. A. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 17: No. 5, 1100-1104(May 1973). (In Russian).

Some characteristic features of the momentum spectra in many-particle reactions $pp \rightarrow pp + m\pi$ and $\pi p \rightarrow p + m\pi$ at high energy are considered in the framework of multiperipheral interaction scheme. (auth)

11744 RATIO OF REAL TO IMAGINARY PARTS FOR pp, $\bar{p}p$, $\pi^\pm p$, and $K^\pm p$ FORWARD ELASTIC SCATTERING AMPLITUDES FROM 50 TO 5000 GeV. Cheng, H. (Massachusetts Inst. of Tech., Cambridge); Walker, J. K.; Wu, T. T. Phys. Lett., 44B: No. 3, 283-285(30 Apr 1973).

Without introducing any additional parameter or assumption, a previous model for hadron scattering based on the impact picture is used to predict the ratio of the real to imaginary parts of various forward elastic scattering processes at high energies. (auth)

11745 CORRESPONDENCE BETWEEN THE IRREGULARITIES OF TRIANGLE FEYNMAN DIAGRAMS AND THE MASSES OF NEGATIVE PARITY BARYON RESONANCES. Dubovoi, E. I.; Yakovenko, V. P. Yadern. Fiz.; 17: No. 5, 1090-1099(May 1973). (In Russian).

For the relativistic Feynman diagram with arbitrary vertex functions the singular part T_Δ is calculated caused by the known logarithmic and square root singularities of the diagram. The singular parts of the corresponding triangle diagrams are shown to be responsible for the maxima in the differential cross sections of elastic scattering and of the K^-- and π-meson interaction with a proton. The positions of the maxima coincide with the masses of the resonances in the $(\pi\Lambda)$, $(\pi\Sigma)$, (KN) systems within 10 MeV accuracy. (auth)

11746 EQUIVALENCE OF THE N* CONTRIBUTIONS IN THE STRONG COUPLING THEORY TO A SCALAR N–N POTENTIAL. Wagner, S. (Univ., Bonn). Z. Naturforsch.; 28a: No. 3-4, 403-407(1973). (In German).

The coupled-channel contribution of N^*_{33} isobars, which appear in the solutions of the fixed-source strong coupling field equations, is equivalent to an effective scalar N–N potential with the range of the sigma-exchange in usual OBE models. (auth)

11747 LINEAR DEPENDENCE OF MASS SPECTRUM ON ISOSPIN. Zamiralov, V. S. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 1, 106-107(1973). (In Russian).

The phenomenological mass formula $M_N^2 - M_\Xi^2 = M_\Lambda^2 - M_\Sigma^2$ which agrees with experimental data was employed to compute octet-related particles with spin parities of $\frac{1}{2}^-$, $\frac{1}{3}^+$, $\frac{3}{2}^-$, $\frac{5}{2}^-$, and $\frac{5}{2}^+$. (KSW)

11748 QUARK-MODEL PREDICTIONS FOR REACTIONS WITH HYPERON BEAMS. Lipkin, Harry J. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 7: No. 3, 846-852 (1 Feb 1973).

Quark-model predictions are discussed for Primakoff excitation of hyperon resonances, total hyperon–nucleon cross sections, and diffractive excitation. The U-spin selection rule forbidding electromagnetic excitation of negatively charged decuplet resonances is shown to hold even in the presence of large SU(3) –symmetry breaking. A new model for diffractive excitation is presented which suggests the existence of new hyperon resonances, not yet discovered, which would be observed in diffractive excitation but only weakly coupled to two–body formation and decay channels. The SU(3) partners of the Roper resonance N(1470) might be such states and be found with hyperon beams. (auth)

11749 RESONANCE DECAYS INVOLVING VECTOR MESONS. Petersen, W. P.; Rosner, J. L. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). Phys. Rev. D 7: No. 3, 747-750 (1 Feb 1973).

A picture of resonance decays using only very general features of the quark model is applied to the case of $\frac{1}{2}^+1^-$ final states. Recent experiments on πN–$N\rho$ provide a crucial test of the model, which predicts correctly the dominant spin of the $N\rho$ system in several cases. (auth)

11750 SIMULTANEOUS FIT FOR FORWARD AND BACKWARD PION–NUCLEON CHARGE–EXCHANGE SCATTERING. Lacombe, M. (Division de Physique Théorique, Institut de Physique Nucléaire, Paris, France); Nicolescu, B.; Mau, R. Vinh. Phys. Rev. D 7: No. 3, 784-789 (1 Feb 1973).

In a previous paper, we proposed a dual resonance model for meson–baryon scattering. It is shown here that this model can account for the existing high–energy pion–nucleon charge–exchange scattering data. (auth)

11751 CONSPIRACY AND REGGE CUTS IN PION–NUCLEON AMPLITUDES. Hanson, Ronald W. (Department of Physics, Arizona State University, Tempe, Arizona 85281). Phys. Rev. D 7: No. 3, 798-804 (1 Feb 1973).

The pion–nucleon amplitudes are analyzed in terms of the conspiracy and strong– and weak–cut Regge–pole models. The weak–cut model has serious difficulty, in that it predicts the wrong sign of the helicity–flip amplitude. The strong–cut model appears to have the correct form for the amplitudes, but has the wrong energy dependence for differential cross sections and polarizations. The conspiracy model is found not to suffer from any serious difficulty. (auth)

11752 ISOSCALAR EXCHANGE IN VECTOR–MESON PRODUCTION. Michael, C. (CERN, Geneva). Nucl. Phys.; B57: No. 1, 292-304(1973).

The I = 0 exchange contributions to $K^*(888)$, $\bar{K}^*(888)$ and ρ-production on nucleons are discussed. The natural-parity exchange components are successfully related using SU(3) and exchange degeneracy for the ω and f_0 Regge poles. Limits on a possible pomeron exchange component are presented. (auth)

11753 FURTHER EVIDENCE FOR A 70, L = 2 BARYON MULTIPLET. Faiman, D.; Rosner, J. L.; Weyers, J. (CERN, Geneva). Nucl. Phys.; B57: No. 1, 45-63(1973).

The recently discovered f-wave dominance of the decay $F_{35}(1877) \rightarrow \Delta\pi$ is interpreted as requiring mixing between 56, L = 2 and 70, L = 2 baryon multiplets. This conclusion is drawn in the context of a broken version of $SU(6)_W$. Further predictions include (a) the existence of a second prominent F_{15} πN resonance around 2 GeV in mass and (b) the more probable dominance of the 1.9 GeV enhancement seen in $\pi^+ p \rightarrow \Sigma^+(1385)K^+$ by P_{33} and P_{31} rather than F_{37} or F_{35} resonances. (auth)

11754 CORRECT ANALYSIS OF NEUTRON-SCATTERING DATA. Bundaru, M. (Inst. of Physics, Bucharest); Stamatescu, I. O. Nucl. Phys.; B53: No. 1, 108-124(1973).

In obtaining neutron-scattering data from deuteron experiments one encounters improperly posed problems which require corresponding treatment. A general method is presented for solving this kind of problem. The question of the stability of the solution is studied, in connection with the approximate nature of the experimental information. Stable total K^+n cross sections are provided, by applying the preceding results, in a search for a possible Z_0 resonance. (auth)

11755 PHENOMENOLOGICAL CHARACTERISTICS OF ABSORPTION IN CHARGE AND HYPERCHARGE-EXCHANGE REACTIONS. Sadoulet, B. (CERN, Geneva). Nucl. Phys.; B53: No. 1, 135-190(1973).

An attempt is made to explain in a unique framework charge- and hypercharge-exchange reactions above 3 GeV/c. The approach is based on exchange degenerate and SU(3) symmetric Regge poles to which absorption corrections are applied. In the absence of a firm theoretical basis for these corrections the approach of fixing the Regge poles through theoretical and phenomenological considerations is adopted: it is then determined what kind of absorption should be applied. At intermediate energy (around 5 GeV/c) the results indicate complete absorption of the s-wave amplitude. Of the two terms 1 and $e^{-i\pi\alpha}$ of the Regge signature factor, the latter should be more strongly absorbed. This effect may explain especially the breaking of line-reversal symmetry for hypercharge-exchange reactions, $\pi^- p \rightarrow \pi^0 n$ polarization data, and the difference of peripherality of ρ-ω and A_2–f_0 contributions. In addition, K-exchange in $\bar{p}p \rightarrow \bar{\Lambda}\Lambda$ was studied. (auth)

11756 PION–NUCLEON PHASE SHIFTS AND PADE APPROXIMANTS. Bergere, M. C.; Drouffe, J. M. (CEN de Saclay, Gif-sur Yvette, France). Nucl. Phys.; B53: No. 1, 191-196(1973).

Pion-nucleon phase shifts at low energy are computed in the non-linear σ model and compared with Yukawa and linear σ model results. Unitarization of a germ and dispersion-relation methods are also discussed. The calculation of Filkov and Palyushev is reproduced exactly but the numerical results disagree with theirs. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 11726 and 11939.

11757 (IPNO-TH-73-4) NUCLEON–NUCLEON INTERACTION FROM PION–NUCLEON PHASE SHIFT ANALYSIS. The NN Peripheral Partial Waves. Vinh Mau, R.; Richard, J. M.; Loiseau, B.; Lacombe, M.; Cottingham, W. N. (Paris Univ.,

Orsay (France). Institut de Physique Nucleaire). 1973. 27p. Dep. NTIS (U. S. Sales Only) $3.50.

The low energy peripheral nucleon–nucleon partial wave phase parameters are calculated from present knowledge of pion–pion and pion–nucleon phase shifts. The results are compared with phenomenological energy independent and energy dependent phase shift analyses. (FR)

11758 (RL-73-3) SHADOW APPROACH TO DIFFRACTION SCATTERING. de Groot, E. H.; Miettinen, H. I. (Rutherford High Energy Lab., Chilton (England)). Apr 1973. 42p. (CONF-730334-2). Dep. NTIS (U.S. Sales Only) $4.25.

The use of s-channel unitarity in calculating high energy elastic scattering from multiparticle production amplitudes is discussed. The important role played by the phases of the production amplitudes for this problem is emphasized. As an illustration of the s-channel techniques, a simplified analysis of high energy (GeV range) elastic proton-proton scattering is performed. (auth)

11759 (RL-73-4) THEORETICAL MODELS OF pp SCATTERING. Phillips, R. J. N. (Rutherford High Energy Lab., Chilton (England)). Apr 1973. 32p. Dep. NTIS (U.S. Sales Only) $3.75.

A brief survey is made of the most popular or recent models of pp elastic scattering at very high energies, including Regge-pole and dual models, various parametrizations of the Pomeron, and scaling models for deep elastic scattering. (auth)

11760 PERTURBATION THEORY FOR THREE-PARTICLE SCATTERING. Bencze, G.; Doleschall, P. (Univ. of Helsinki). Phys. Lett.; 44B: No. 3, 235-237(30 Apr 1973).

Arguments are given that the Alt-Grassberger-Sandhas (AGS)-type perturbation theory is to be preferred to that developed by Sloan and Pieper. It is shown that the first order AGS approximation can be trivially incorporated into the formalism of the three-particle equations. The AGS perturbation theory is applied to n–d scattering and the results are compared to those of the exact calculations. (auth)

11761 pp ELASTIC SCATTERING AT LARGE MOMENTUM TRANSFER. Landshoff, P. V.; Polkinghorne, J. C. (Cambridge Univ., Eng). Phys. Lett., 44B: No. 3, 293-295(30 Apr 1973).

It is pointed out that if one imposes the restrictions $s > 15$ $(GeV)^2$ and $t > 2.5$ $(GeV)^2$ the data for p + p elastic scattering appear to be in agreement with the expression $d\sigma/dt - s^{-11} f(\theta)$. (JFP)

11762 INTERNAL STRUCTURE FOR THE PIONIZATION SPECTRUM. Barnett, R. M.; Silverman, D. (Univ. of California, Irvine). Phys. Lett., 44B: No. 3, 281-282(30 Apr 1973).

Peripheral models for the inclusive q^2 spectrum in the central plateau region are considered in a unified treatment. The highest energy ISR spectrum for $p + p \rightarrow \pi + X$ is fit for all $q_\perp$.

11763 GENERATION OF CHARGED PARTICLES BY π^--MESONS ON LIGHT NUCLEI AT HIGH ENERGY. Grishin, V. G.; Eliseev, S. M.; Inogamov, Sh. V.; Kohli, J. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 5, 1017-1024(May 1973). (In Russian).

The multiplicity distributions of particles produced in inelastic interactions of pions with light nuclei are studied. The calculations are based on the model of multiple scattering of particles inside the nuclei. The theoretical results are compared with the data from the JINR two-meter propane chamber and with the emulsion data. (auth)

11764 POSSIBLE BEHAVIOR OF THE INELASTIC CROSS SECTION OF THE NUCLEON INTERACTION WITH AIR NUCLEI AT ENERGIES HIGHER THAN 30 GeV. Akimov, V. V.; Kozlov, V. D.; Shestoperov, V. Ya. (Moscow State Univ.). Yadern. Fiz.; 17: No. 5, 1025-1027(May 1973). (In Russian).

The results are presented of calculations of hadronic spectra at the 700 g/cm^2 atmosphere depth. The assumption (following from the experiments with a "proton" satellite) is made that the primary cosmic ray spectrum exponent grows at an energy of about $2(10)^{12}$ eV and the inelastic cross section of the proton interaction with light nuclei increases with increasing energy. The theoretical results are shown to agree with the experimental data if one assumes that the increase of the cross section ends at $3(10)^{11}$ to 10^{12} eV proton energy. (auth)

11765 $3\pi\gamma$-INTERACTION IN PION INELASTIC SCATTERING ON HEAVY NUCLEI. Iroshnikov, G. S.; Kotova, L. P. (Physical-Technical Inst., Moscow). Yadern. Fiz.; 17: No. 5, 1045-1051 (May 1973). (In Russian).

The Coulomb contribution to the integral cross section of the reaction is calculated. The ω-pole exchange is shown to dominate in the strong interaction. The data of I. Vorob'ev et al., Yad Fiz 17, 3(1973) give the limit $\Lambda \leq 12$ for the $3\pi\gamma$-coupling constant. (auth)

11766 COMPARISON OF APPROXIMATE AND ACCURATE RESULTS FOR LOW-ENERGY n–d SCATTERING. Krasnopol'skii, V. M.; Kukulin, V. I. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 1, 20-27(1973). (In Russian).

Low-energy n–d scattering was examined with the method of resonant groups. A comparison was made of the results obtained with the results of solving Faddeev's equations for the same potentials. Conclusions were reached as to the complexity of the system (with $A > 3$) describable by the method of resonant groups. (tr-auth)

11767 PION-DEUTERON SCATTERING AT HIGH ENERGIES. Sidhu, Deepinder P.; Quigg, C. (Institute for Theoretical Physics-State University of New York, Stony Brook, Long Island, New York 11790). Phys. Rev. D 7: No. 3, 755-764 (1 Feb 1973).

Glauber theory, including the complications of spin and isospin, is applied to high-energy πd scattering. We compare theoretical predictions with recent experimental results on total and differential elastic cross sections. Particular attention is given to the suggestion of new experiments which bear on possible modifications of the Glauber picture. (auth)

11768 EXTRACTION OF ASYMPTOTIC NUCLEON CROSS SECTIONS FROM DEUTERIUM DATA. Atwood, W. B. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 93405); West, Geoffrey B. Phys. Rev. D 7: No. 3, 773-783 (1 Feb 1973).

The effect of Fermi motion on the extraction of asymptotic total neutron cross sections from deuterium data is examined in some detail. Particular attention is paid to the threshold condition on the nucleon cross sections. Using realistic hard-core wave functions to describe the deuteron, we find that, with this added correction, the Glauber mean inverse square radius of the deuteron is experimentally determined to be 0.0212 ± 0.005 mb^{-1}, in good agreement with values calculated using hard-core wave functions. Previous discrepancies in πN and NN scattering are shown to be eliminated. When applied to the real photoabsorption total cross section our correction considerably reduces the neutron–proton difference, making it consistent with zero in the asymptotic region. We also examine deep-inelastic electron–deuteron scattering and show how the theory gives an excellent description of the quasielastic peak. For scattering into the continuum we find that the correction far away from threshold is $\sim$5%, while near the threshold it can become very large ($\sim$30%). In terms of the neutron–proton ratio the correction is generally very small (i.e., the smeared ratio is an excellent approximation to the unsmeared) unless this ratio drops below $\sim 1/4$ near threshold. (auth)

11769 ISOBAR EXCHANGE EFFECTS IN p–d BACKWARD INELASTIC SCATTERING. Bhasin, V. S.; Duck, I. M.; Valkovic, V. (Rice Univ., Houston, TX). Phys. Lett.; 44B: No. 4, 317-320(14 May 1973).

The effects due to nucleon and isobar exchanges in the inelastic contribution to p-d backward scattering at 1.0 GeV are studied. The results are sensitive to the details of the model and will provide a test of assumptions used in the corresponding elastic scattering theory. (auth)

11770 ELASTIC SCATTERING OF π-MESONS FROM DEUTERONS. Petrov, N. M.; Peresypkin, V. V. (Inst. for Theoretical Physics, Kiev). Phys. Lett.; 44B: No. 4, 321-323(14 May 1973).

On the basis of Faddeev integral equations the problem of the elastic scattering of π-mesons from deuterons is considered. The pion-deuteron scattering length is calculated under the assumption that there is only S-wave interaction between the particles. (auth)

11771 T/S SCALING IN EXCLUSIVE AND INCLUSIVE PROTON REACTIONS. Horn, D.; Moshe, M. (California Inst. of Tech., Pasadena). Contract AT(11-1)-68. Nucl. Phys.; B57: No. 1, 139-156(1973).

A model is developed in order to account for the previously observed large-angle behavior in elastic scattering, and to predict the analogous inclusive effects. Data of (pp,p) distributions and $pp \rightarrow pN^*$ reactions are examined in regions of high transverse momenta and fitted by the functional forms of the model. The fits show the expected features of this new type of high-energy scaling. (auth)

Particle Invariance Principles and Symmetries

General

11772 (COO-3533-10) RELATIVISTIC INVARIANCE AND DISCRETE SYMMETRIES. Balachandran, A. P. (Syracuse Univ.,

N. Y. Dept. of Physics). Dec 1972. Contract AT(11-1)-3533. 8p. (CONF-720732-1; SU-4205-10). Dep. NTIS $3.00.

From symposium on unsolved problems at the Indian Institute of Science; Bangalore, India (17 Jul 1972).

An outline is given of the method whereby geometric transformations like rotations and space time translations are implemented as invariance transformations in quantum mechanics. (LBS)

11773 WEYL GROUP: A SURVEY. Wolf, K. B.; Garcia, A. (Univ. Nacional Automa de Mexico, Mexico City). Rev. Mex. Fis.; 21: No. 3, 191-218(1972).

Some of the properties and representations of the Weyl group, the three-parameter Lie group generated by the (Weyl) algebra realized in quantum mechanics by the coordinate, momentum and unity operators are surveyed. One-dimensional coset spaces are considered as homogeneous spaces under the group and, taking plane-wave and harmonic oscillator eigenfunction bases, all the unitary irreducible representation matrices of the group are constructed. Some previously published material on the Weyl group as a deformation of a semisimple group, on non-Schroedinger realizations, on some of its enveloping algebras is added and placed in the context of the general nilpotent groups. (auth)

11774 SYMMETRY GROUPS AND THEIR APPLICATIONS. Miller, W. Jr. Pure and Applied Mathematics. Volume 50. New York; Academic Press, Inc. (1972). 442p. $25.00.

The aspects of group theory that are useful in the physical sciences are treated. Distinguishing features of the book include: a systematic derivation of crystallographic point and space groups; a simplified yet precise presentation of the theory of local linear Lie groups; a construction of the representations of classical groups using both weights and Young diagrams; an integrated theory which includes applications not only to classical and quantum physics but also to geometry and special function theory. Other topics are covered such as Clebsch–Gordon coefficients, the Wigner–Eckart theorem, equations invariant under the Euclidean and Poincare groups, and the theory of local Lie transformation groups. Selected applications to quantum mechanics are included. (LBS)

11775 GROUP THEORETICAL DERIVATION OF THE GRIBOV–LIPATOV RECIPROCITY RELATION. Ferrara, S. (CNEN, Rome); Gatto, R.; Parisi, G. Phys. Lett.; 44B: No. 4, 381-382(14 May 1973).

The Gribov–Lipatov reciprocity relation is shown to follow directly from group-theoretical considerations employing the conformal group. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 11642 and 11740.

11776 VIOLATION OF CP INVARIANCE IN THE DYON MODEL. Chu, Shu-Yuan (Department of Physics, Indiana University, Bloomington, Indiana 47401). Phys. Rev. D 7: No. 3, 853-856 (1 Feb 1973).

The CP-violation mechanism proposed by Schwinger in the dyon model is discussed. It is pointed out that, once dual-charged particles are introduced, we have two kinds of smallest units of electric charge for magnetically neutral particles: one for purely electrically charged particles, the other for the magnetically neutral composites of the dyons. These two units, which, a priori, could be different, are assumed to be the charges carried by the electron and the proton, respectively. Schwinger's mechanism can then be understood as a self-consistent condition that ensures the equality of these two units of electric charge. The analogy between this mechanism and that proposed by Bernstein, Feinberg, and Lee is discussed. The case of neutral-K decay is briefly analyzed. The magnitude of the CP-violation parameter in different processes is estimated. (auth)

Applications (Strong)

Refer also to abstract 11748.

11777 CASUAL GHOST-FREE COVARIANT HARMONIC OSCILLATOR MODEL FOR BOSONS RESPECTING CPT AND ALL THAT. Bacry, H. (CNRS, Marseille); Chang, N. P. Phys. Lett., B; 44B: No. 3, 286-288(30 Apr 1973).

The quantization of a new infinite-component wave equation is discussed. The quantized field satisfies microcausality and has momentum support in the time-like region with a mass^2 spectrum equal to that of a relativistic harmonic oscillator with no ghosts. This model field theory does not violate the spin-statistics theorem and is CPT invariant. (JFP)

11778 CIRCULAR POLARIZATION OF THE γ-QUANTA FROM THE $n + p \rightarrow d + \gamma$ REACTION AND THE WEAK P-ODD NNρ VERTEX. Danilov, G. S. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 17: No. 5, 1052-1062(May 1973). (In Russian).

Theoretical estimates of the circular γ-polarization in the reaction $n + p \rightarrow d + \gamma$ usually give the value two orders lower than the experimental one. These estimates are based on the commonly accepted value of the constant $\Gamma(m_\rho^2)$ of weak P-odd interaction between nucleons and ρ mesons, derived from the simplest diagram. It is shown that the diagrams for $\Gamma(m_\rho^2)$ which are not usually taken into account, in fact quadratically diverge and therefore have a large value (the density of the weak Hamiltonian is assumed to be of the form "current × current"). If the cutoff parameter Λ in the quadratically divergent integral determining the quantity $\Gamma(m_\rho^2)$ is chosen to be $\Lambda \sim 10$ GeV, then the contradiction between theoretical estimations and experiment disappears. (auth)

Scattering Theory

11779 (COO-3130-TA-285) TWO-REGGEON CUT PROBLEMS. Kang, K. (European Organization for Nuclear Research, Geneva (Switzerland); Paris Univ., Orsay (France); Brown Univ., Providence, R. I. Dept. of Physics). 27 Apr 1973. Contract AT(11-1)-3130. 7p. (CONF-730334-3). Dep. NTIS $3.00.

The two-Reggeon cut problem is reviewed in the light of recent developments concerning the notion of two-Reggeon irreducibility. (auth)

11780 (JINR-P2-7142) MODIFIED SERIES OF PERTURBATION THEORY FOR THE CASE OF SCATTERING ON SINGULAR NONRENORMALIZED POTENTIAL. Gogokhiya, V. Sh.; Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 22p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.25.

A method of construction of modified series of perturbation theory is formulated and completely validated by the example of the Schroedinger equation with the singular potential. The method is applicable also for the case of quantum field theory with non-renormalized interaction. It is shown that interpolated solutions can be reduced with any accuracy. In conclusion interpolated equations are compared with the "peratization" approximations and cutting in "unitary limit." (auth)

11781 SPIN EFFECTS IN ELASTIC SCATTERING AT ANGLES CLOSE TO 180°. Arkhipov, A. A.; Belov, V. K.; Savrin, V. I. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 17: No. 5, 1111-1119(May 1973). (In Russian).

The spin-orbit interaction is taken into account in the elastic scattering at angles close to 0 and 180°. (auth)

11782 CONSTRUCTION OF SOLVABLE MODELS OF THE MANY BODY PROBLEM. Schuette, D. (Univ., Bonn). Z. Naturforsch; 28a: No. 3-4, 396-403(1973).

The construction of subalgebras of the set of bilinear products of fermion operators which allow the formation of physically relevant solvable models is investigated. The subalgebras are assumed to be semisimple, hermitean closed and compatible with angular momentum. One obtains two classes of subalgebras, the well known set of spherical tensors of rank zero and a new class of subalgebras which contain the angular momentum operators. The construction procedure for subalgebras of the second kind is presented in detail (hereby, one starts with the abstract type of the subalgebra and defines the physical model space by the carrier space of a representation), and a number of examples, which provide models not known from the literature, are given. (auth)

11783 APPLICATION OF THE REAL WEINBERG STATES IN POTENTIAL SCATTERING. Liu, Q. K. K. (Hahn-Meitner Institut fuer Kernforschung, Berlin). Z. Phys.; 258: No. 4, 301-314 (1973).

The first step is given in a systematic application of a resonant scattering theory due to Huby in which the real Weinberg state is the crucial feature. The scattering cross sections of $l = 0, 1, 2$ partial waves in a square well potential are calculated with the aid of the real Weinberg states. Perfect agreement with the exact calculation is obtained. Approximate cross sections resulting from a schematic approximation in the formalism which, apart from other desirable features, display the Breit–Wigner energy factor in the phase shifts, are also found to agree perfectly with the exact calculation. Some simple approximations of the complex and real Weinberg states are investigated, but none is found to be satisfactory for $l > 0$ partial waves in complete contrast to works of previous authors on the $l = 0$ partial wave. (auth)

11784 QUANTUM MECHANICAL N-BODY SYSTEM. Schtalheim, A. Diss. No. 4602. Zurich; Eidgenoessische Technische Hochschule (1970). 109p.

Thesis.

A quantum mechanical system of N nonrelativistic particles is considered. The solutions of the Faddeev–Yakubovsky equations below the 4-particle threshold s_4 are discussed. The results are used for a proof of the unitarity of the scattering operator below s_4 and for the definition of scattering cross sections for the 2-n scattering below s_4 and the 3-3 scattering in 3-body systems. (auth)

11785 SEPARABLE EXPANSIONS OF THE T-MATRIX. Sloan, I. H.; Gray, J. D. (Univ. of New South Wales, Kensington, Australia). Phys. Lett.; 44B: No. 4, 354-356(14 May 1973).

A recent result of Osborn on the non-convergence of separable expansions of the t-matrix $t(p,p';z)$ is discussed. It is shown that the theoretical difficulties arise from large values of p and p', and cause no difficulties in practical situations. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

11786 DYNAMICS OF SUPERFLUID VORTICITY IN NON-DISSIPATIVE PROCESSES. Lhuillier, D.; Francois, M. (Campus Univ., Orsay, France). Phys. Lett.; 44A: No. 2, 118-120(21 May 1973).

The consequences of the possible existence of superfluid vorticity on the Landau two-fluid equations is investigated. Assuming a conservation law for superfluid circulation, it is shown that in nondissipative situations, the superfluid vorticity is swept along by the normal fluid. (auth)

Superconductivity

Refer also to abstract 11281.

11787 (AD-753359) STUDIES OF SUPERCONDUCTING THIN FILM CARBIDES AND NITRIDES. Report No. 6 (Final). Somasundaram, R.; Toth, L. E. (Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science). Jul 1971. Contract DAAK02-70-C-0181. 25p. NTIS.

Thin films of niobium nitride prepared by reactive sputtering have an excellent combination of superconducting characteristics. A major problem in using these nitrides has been the varied and often contradictory descriptions of how to prepare the films to obtain a desired set of superconducting properties. The problem of consistency and transferability of results can be partially resolved if one pays attention to the structure and composition of the films and not necessarily to the mechanics of sputtering. In this study an attempt was made to vary the sputtering conditions and correlate the superconducting properties of NbN and related alloys with the film's composition and structure. It is found that relatively small changes in sputtering conditions often resulted in large changes in superconducting properties. In every case the results can be explained when film structure and composition were characterized. The study included the nitrides and carbides of niobium and tantalum. Both d.c. and a.c. sputtering techniques were used. (auth)

11788 (N-73-13731) INVESTIGATION OF SUPERCONDUCTING INTERACTIONS AND AMORPHOUS SEMICONDUCTORS. Final Report. Janocko, M. A.; Jones, C. K.; Gavaler, J. R.; Deis, D. W.; Ashkin, M.; Mathur, M. P.; Bauerle, J. E. (Westinghouse Electric Corp., Pittsburgh, Pa.). Oct 1972. Contract NASw-1760. 245p. (NASA-CR-129524). NTIS.

Research papers on superconducting interactions and properties and on amorphous materials are presented. The search for new superconductors with improved properties was largely concentrated on the study of properties of thin films. An experimental investigation of interaction mechanisms revealed no new superconductivity mechanism. The properties of high transition temperature, type 2 materials prepared in thin film form were studied. A pulsed field solenoid capable of providing fields in excess of 300 kOe was developed. Preliminary x-ray measurements were made of V_3Si to determine the behavior of cell constant deformation versus pressure up to 98 kilobars. The electrical properties of amorphous semiconducting materials and bulk and thin film devices, and of amorphous magnetic materials were investigated for developing radiation hard, inexpensive switches and memory elements. (STAR)

11789 SUPERCONDUCTIVITY AND SIGMA-PHASE Nb–Al. Mueller, A. (Siemens AG, Erlangen, Ger.). Z. Naturforsch.; 28a: No. 3-4, 472-474(1973). (In German).

The preparation and the alloy structure of Nb–Al samples containing sigma-phase are described. Using single-phase material, it is shown that the sigma–phase Nb–Al, independent of composition and heat treatment, is not superconducting down to 1.3°K. (GE)

11790 SUPERCONDUCTIVITY OF $LaOs_2$. Lawson, A. C.; (Univ. of California, San Diego, La Jolla); Cannon, J. F.; Robertson, D. L.; Hall, H. T. J. Less-Common Metals; 32: No. 1, 173-174(Jul 1973).

The magnetization in a 30-Oe field shows superconducting transitions of cubic and hexagonal (high-pressure and temperature) $LaOs_2$ at 8.9 and 5.9°K, respectively. Comparison of the unit cell volumes of cubic and hexagonal $LaOs_2$, $CeOs_2$, and $PrOs_2$ shows that for $CeOs_2$, no significant compression occurs at all as a result of the cubic–hexagonal conversion, and therefore superconductivity of hexagonal $CeOs_2$ is not expected. (DLC)

11791 NONLOCAL EXTENSIONS OF THE GINZBURG–LANDAU THEORY FOR TYPE-II SUPERCONDUCTORS VALID AT ALL TEMPERATURES. Brandt, E. H. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi (b); 57: No. 1, 277-287(1 May 1973).

The free energy of a superconductor is expressed as a two-dimensional infinite series that may be interpreted in three different ways: as an expansion with respect to a) the gap parameter, b) the gauge-invariant gradient, or c) the temperature difference $T_c - T$. By partial summation of the series we obtain a simple nonlocal functional containing as special cases the extended Ginsburg–Landau theory (Neumann–Tewordt) and the nonlocal electrodynamics (Pippard, Gorkov). For small magnetization it gives the exact gap (Helfand–Werthamer) and the magnetic field distribution (Delrieu) in the entire temperature range $0 \leq T < T_c$. In the general case the functional is expected to be a good approximation for $T > 0.7\ T_c$. By numerical minimization of the functional one may hope to solve fairly complicated problems such as, e.g., the perturbed flux-line lattice. (28 references) (auth)

Equipment and Devices

11792 COUPLING ENERGY DEPENDENCE OF SPECTRAL PROPERTIES IN WEAK SUPERCONDUCTING CONTACTS. Dmitrenko, I. M.; Bevza, Yu. G.; Karamushko, V. I. (Physical-Technical Inst. of Low Temperatures, Kharkov). Phys. Status Solidi (a); 17: No. 1, 59-64(16 May 1973).

The sensitivity to the type of dependence between the supercurrent and the quantum phase is investigated for the $I_n(i)$ dependence of the zero-currents and current steps in the U-I curves of the Josephson point contacts on the amplitude of an external electromagnetic wave, i. Especially the discrepancies are considered between the calculated and the experimental data on the spectral properties of the Josephson contacts which rise, due to the use of a simple $j(\varphi) \sim \sin \varphi$ function independently of the coupling energy in the weak superconducting contact. A possible technique for the construction of the $j(\varphi)$ function by experimental $I_n(i)$ curves is proposed. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

11793 (ORNL-TM-4232) GAMMA-RAY DUE TO NEUTRON INTERACTIONS WITH ALUMINUM FOR INCIDENT NEUTRON ENERGIES BETWEEN 0.85 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 118p. Dep. NTIS $8.00.

Numerical values of differential cross sections for gamma rays produced by neutron reactions with aluminum were obtained for neutron energies between 0.85 and 20 MeV for θ_γ = 125 and 90 deg. The $d^2\sigma/d\omega dE$ values were obtained using a NaI spectrometer. These data consist of neutron and gamma-ray production group cross-section values of $d^2\sigma/d\omega dE$ for $0.7 \leq E_\gamma \leq 10.5$ MeV, with gamma-ray intervals ranging from 20 keV for $E_\gamma \leq 1$ MeV to 160 keV for $E_\gamma \approx 9$ MeV. Neutron energy intervals varied from 0.2 MeV for E_n = 0.85 to 1.5 MeV to 3 MeV for E_n = 14 to 20 MeV. (auth)

11794 (RT/FI-(73)4) STOCHASTIC KINETICS. 1. Neutronics. Jorio, V. M.; Pacilio, N. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 6 Feb 1973. 53p. (In Italian). Dep. NTIS (U. S. Sales Only) $4.75.

Nuclear reactor kinetics is formulated according to a stochastic approach. The Chapman-Kolmogorov equations are written for the probability of finding the neutron population at a given level for a given instant. Equations are integrated in search of a probability profile: six cases are analyzed via a progressive criterium. It tends to take into account an increasing number of physical processes within the chosen model. (auth)

11795 (RT/FI-(73)6) CALCULATION OF THE COEFFICIENT OF ANISOTROPIC DIFFUSION IN CYLINDRICAL CAVITIES AND OF THE GENERALIZED FORM XY. Anton, V. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 5 Feb 1973. 38p. (In Italian). Dep. NTIS (U. S. Sales Only) $4.00.

The anisotropic diffusion coefficients Dr Dz are explicitly derived in cylindrical cavities and in shells. The resulting formulas being complicated, a numerical integrated method is firstly attempted, and subsequently a finite difference method which calculates the coefficients Dx Dy Dz in a XY generalized cavity is carried out. (auth)

11796 (WAPD-TM-1098) COMPUTATION OF RIGOROUS ERROR BOUNDS FOR NUMERICAL SOLUTIONS OF THE NEUTRON TRANSPORT EQUATION. Madsen, N. K. (Bettis Atomic Power Lab., Pittsburgh, Pa). Mar 1973. Contract AT-11-1-GEN-14. 20p. Dep. NTIS $3.00.

When one computes approximate numerical solutions to partial differential equations, questions of accuracy always arise. One seldom has anything more than intuition and occasional experimental results to judge the accuracy of the numerical results. The theory and application of two methods for computing rigorous a posteriori error bounds for numerical solutions to time-independent neutron transport problems in rectangular geometry are reported. One of the methods deals with the computation of L_2 and L_1 norm bounds for the error function. The other method is used to compute pointwise error bounds for the directional and scalar neutron fluxes. The methods can be adapted for use with almost any existing discrete ordinates computer program. Test results for several problems are also presented. (auth)

11797 MODERATION OF SUBTHERMAL NEUTRONS BY A SYSTEM OF ROTATING PLANE NEUTRON MIRRORS. Kashukeev, N. T.; Mircheva, D. S.; Yaneva, N. B. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 1, 51-54(1973). (In Russian).

The moderation of neutrons brought about by the so-called "mechanical generator of ultracold neutrons"—a system of revolving flat neutron mirrors—was calculated from the kinematic dependence of neutron interaction with a rotating, reflecting wall with the aid of a FORTRAN program. Graphs represent the velocity distribution of incident and of "cooled" neutrons, and the angular distribution of the entry of the ultracold neutrons in a neutron guide. (KSW)

11798 STUDY OF NEUTRON DIFFUSION LENGTHS IN HETEROGENEOUS, NONMULTIPLYING PLATE ASSEMBLIES. Siddiqui, S. A. M. M.; Williams, M. M. R. (Queen Mary Coll., London). J. Nucl. Energy; 27: No. 5, 273-301(May 1973).

A study of the diffusion length of neutrons in an infinite lattice of alternate slabs of two different materials in the direction parallel to the slabs has been carried out on the basis of integral transport theory. In the one-velocity approximation, curves are obtained, numerically, for aluminium-water lattices from which can be observed the possibility of the existence or non-existence of a discrete decay constant ν for a given configuration. In the energy-dependent case, two of the configurations studied by Palmedo and Conant have been chosen, and it has been shown that neither possesses a discrete decay constant, which is consistent with their experimental findings. The asymptotic spectra in the aluminium and water regions for certain configurations have also been discussed. Calculations are made for the lead-water systems studied experimentally by Mukhin and others, and satisfactory agreement is obtained. (auth)

11799 CONCEPT OF ENERGY-DEPENDENT BUCKLING IN MULTIGROUP DIFFUSION THEORY. 3. Beynon, T. D. (Univ. of Birmingham, Eng.). J. Nucl. Energy; 27: No. 5, 327-334(May 1973).

The analysis developed in an earlier paper is applied to a small, highly enriched homogeneous fast reactor to evaluate the critical mass of ^{235}U. Numerical results indicate that the energy-dependent buckling analysis gives superior results to the conventional constant-buckling approach, particularly for the fundamental mode approximation. For the fast system investigated the best choices of constant buckling are obtained by selecting from those energy regions with atypically low leakage and high reactivity importance. (auth)

11800 MEASUREMENT OF THERMAL NEUTRON WAVES AT HIGH FREQUENCIES IN BeO. Ritchie, A. I. M.; Whittlestone, S. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Nucl. Energy; 27: No. 5, 335-350(May 1973).

The amplitudes and phases of neutron waves have been measured in a BeO assembly in the frequency range 515.7 Hz to 1719 Hz. The results confirm earlier measurements that below ~520 Hz the neutron wave has the properties of a discrete mode of propagation. At frequencies ≥720 Hz the attenuation $\alpha(z)$ and phase shift parameters $\xi(z)$ change with distance from the source, the change being more marked the higher the frequency. The observed spatial variations of $\alpha(z)$ and $\xi(z)$ do not agree with present theoretical predictions. Interference effects predicted by theory have not been observed. (auth)

11801 SELF-SHIELDING COEFFICIENT OF PLATES AGAINST NEUTRON FLUXES. Khristov, Kh.; Raichev, P. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 22: 41-54(1972).

The "sounding method" for determining the density of neutrons in a given neutron flux is discussed. With the thicker sondes usually preferred, the self-shielding effect must be taken into consideration. The self-shielding coefficient is calculated by a method similar to the method of successive approximations for the transport of γ quanta through matter; the assumptions involved, usually fulfilled in practice, are explicitly stated. (RWR)

11802 NEUTRON THERMALIZATION IN HEAVY WATER; AN INVESTIGATION. Wydler, P. Diss. Nr. 4223. Zurich; Eidgenoessische Technische Hochschule (1968). 83p.

Thesis.

To check different scattering models for heavy water time dependent and steady state spectrum measurements were made. The time dependent spectra were measured in the pure moderator using a pulsed source and a chopper. The steady state spectra were observed in cadmium solutions at various distances from a source of fast neutrons provided by a reactor. The neutrons were analyzed by time of flight. Calculations based on diffusion and transport theory were made using the free gas model, the Nelkin-Honeck model and the Haywood scattering kernel for D_2O. The kernels were found to predict quite different thermalization properties. Theoretical spectra based on the Haywood kernel agreed best with the experimental results. (auth)

11803 WIENER-HOPF TECHNIQUE: AN ALTERNATIVE TO THE SINGULAR EIGENFUNCTION METHOD. Williams, M. M. R. (Univ. of London). Advan. Nucl. Sci. Technol.; 7: 283-327(1973).

After a historical introduction, the basic theory of the Wiener-Hopf method is discussed for the integral equation and the integro-differential equation. Applications to the critical problem, to spherical and cylindrical systems, and to rectangular systems (one-speed Milne problem, diffusion length problem) are examined. Finally, energy-dependent problems and time-dependent problems are considered. (4 figures, 2 tables, 101 references) (RWR)

11804 SINGULAR EIGENFUNCTION EXPANSIONS IN NEUTRON TRANSPORT THEORY. McCormick, N. J.; Kuscer, I.

(Univ. of Ljubljana, Yugoslavia). Advan. Nucl. Sci. Technol.; 7: 181-282(1973).

The article presents in detail the basic principles of the singular eigenfunction methods, demonstrates how these principles may be used to solve some idealized problems in transport theory, and provides an overall survey of the problems that have been treated in this way. The reader is assumed to be familiar with the basic concepts of transport theory, although some background material is presented. Most of the paper deals with transport in an infinite medium and in half-space media: standard and extended one-group formalisms, continuous speed, and the multigroup approximation are included. Eigenmode expansions of appropriate solutions are also considered for the infinite medium case. Then transport in slabs is taken up, for both bare slabs and multilayered systems. Nonplane boundaries are then considered in the general case and for spherical symmetry; an approximate treatment of transverse coordinates in prisms is also given. Finally, the merits of singular eigenfunctions are compared with those of other methods. (7 figures, 5 tables, 284 references) (RWR)

Nuclear Properties and Reactions, A ≤ 5

11805 (JINR-P2-7086) PIONIC COUPLING CONSTANT AND PIONIC RADIUS OF ^{3}He. Kopeliovich, B. Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 14p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The dispersion relation with subtraction for pionic form factor of ^{3}He is analyzed. The subtraction constant G(0) is defined through PCAC and Goldberger–Treiman relation. The contribution to the absorptive part of anomalous cut is calculated in standard way. The linear behavior of nucleon pionic form factor is assumed. The corresponding correction $\delta(\mu^2)$ to the $\pi-^3$He coupling is $\delta_1(\mu^2) = 0.26$. The couplings of ^{3}He–pd and ^{3}He–pd$_s$ are assumed to be equal because p–n singlet and triplet states are contained in the dominant S-state of ^{3}He with equal weights. The pionic radius of ^{3}He (17) is equal 1.52 μ^{-1}. For the charge radius of ^{3}He (19) 1.33 μ^{-1} is obtained in excellent agreement with experimental value 1.35 μ^{-1}. Because of the uncertainties in the behavior of nuclear form factor at large t and ^{3}He–pd$_S$ coupling direct calculation of Feynman diagrams is demonstrated, which does not contain the above uncertainties but another one concerning nucleon form factor behavior when nucleon is off the mass shell. An expression is obtained for pionic form factor of ^{3}He which is proportional to the charge form factor. For $\delta(\mu^2)$ the value 0.37 is obtained, which is close to the one of the above-mentioned. (LBS)

11806 (KFK–1783) EXPERIMENTS ON THE KARLSRUHE CYCLOTRON IN THE YEAR 1972. Rebel, H.; Schatz, G. (Kernforschungszentrum, Karlsruhe (West Germany). Zyklotron-Laboratorium). Mar 1973. 164p. (In German). Dep. NTIS (U. S. Sales Only) $10.25.

The various experimental activities at the Karlsruhe Isochronous Cyclotron during the year 1972 are reviewed. Short surveys on investigations in the fields of neutron physics, nuclear reactions, nuclear spectroscopy, magnetic moments and hyperfine interactions, radiochemical studies, material research, medical and engineering applications, and developments of new apparatuses are presented. (auth)

11807 BOUND-STATE PROPERTIES OF THREE AND FOUR NUCLEONS WITH REALISTIC FORCES. Demin, V. F.; Pokrovskii, Yu. E.; Efros, V. D. (Inst. of Atomic Energy, Moscow). Phys. Lett.; 44B: No. 3, 227-230(30 Apr 1973).

Three and four nucleon bound-state problems were solved in the frame of the hyperspherical basis for "realistic" NN-potentials. The ^{4}He binding energy appeared to be rather close to the experimental value. The role of different components of the potential is discussed. (auth)

11808 CALCULATIONS OF THE TRITON BINDING ENERGY FOR REID'S SOFT-CORE NUCLEON–NUCLEON INTERACTION. Bruinsma, J.; van Wageningen, R. (Vrife Univ., Amsterdam). Phys. Lett.; 44B: No. 3, 221-223(30 Apr 1973).

The triton energy E_T was calculated variationally for Reid's soft-core potential. The L · S-term and the $^1D_2$, $^3D_2$ states contribute –2 MeV and +0.2 MeV resp. The odd-state contribution is negligibly small. The results are compared with those of other authors. (auth)

11809 PROBLEMS OF FOUR IDENTICAL PARTICLES WITH SEPARABLE INTERACTION. Kharchenko, V. F.; Kuz'michev, V. E. (Inst. of Theoretical Physics, Moscow). Yadern. Fiz.; 17: No. 5, 975-987(May 1973). (In Russian).

The problem of four identical spin-zero particles with separable pairing interaction is considered. The integral equations of motion are formulated for the bound four-particle state and for the states in the continuous spectrum for the case of two noninteracting subsystems in the initial state. The calculations are carried out for the case of bound four-particle states. Besides the ground four-particle state, the excited bound 0^+-state with the energy which exceeds slightly of three-particle ground state is found. The binding energy of the ^{4}He ground state is calculated in the approximation of the totally symmetrical space wave function. (auth)

11810 NORMALIZATION OF THE p–^{3}H AND n–^{3}He TAILS OF ^{4}He AND THE ^{4}He CHARGE FORM FACTOR. Lim, T. K. (Drexel Univ., Philadelphia). Phys. Lett.; 44B: No. 4, 341-342(14 May 1973).

It is known that suitable Eckart parametrizations of the nucleon-trinucleon overlap functions are able to reproduce the charge form factor of ^{4}He. The extracted relative normalization constants of the asymptotic nucleon functions are $C_n \approx 4.1$ and $C_p \approx 4.0$. (auth)

11811 REGGE REPRESENTATION OF NUCLEAR SCATTERING INCLUDING BACKGROUND: $\alpha-\alpha$ Elastic Scattering. Pearce, W. A. (McMaster Univ., Hamilton, Ont.). Nucl. Phys.; A208: No. 3, 429-448(1973).

$\alpha-\alpha$ elastic scattering is characterized by the Regge trajectories determined from the 0^+, 2^+, 4^+, 6^+ rotational states together with an explicit background term arising from direct processes. Calculations using a simple model containing the triangle singularity are compared with experimental results. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 11639, 11806, 11863, 11869, 11874, 11910, and 11933.

11812 (KFK–1518) TOTAL NEUTRON CROSS SECTION OF BORON 10 BETWEEN 90 AND 420 keV. Spencer, R. R.; Beer, H.; Froehner, F. H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Apr 1973. 8p. (EANDC(E)–147(AL)). Dep. NTIS (U. S. Sales Only) $3.00.

The neutron total cross section of ^{10}B has been determined between 90 and 420 keV neutron energy by means of a transmission measurement of an enriched ^{10}B sample. Deviations in shape from other measurements are within the statistical accuracy of the present measurement and smaller than 1.5%. In the measured energy region no indication of narrow resonance structure was found, and the deviation of the total cross section from an $E^{-\frac{1}{2}}$ energy dependence above 100 keV was confirmed. (1 figure, 1 table) (auth)

11813 (ORNL-4844) PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1972. Obenshain, F. E. (ed.) (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 310p. Dep. NTIS $3.00.

Much of the work reported is presented in the form of abstracts of papers already published or submitted for publication. Work not in this category is described more fully, but not in any detail. The contents of the report are divided into the following sections: theory; high-energy physics; nuclear structure, reactions, and radioactivity; fission; Moessbauer spectroscopy; atomic and molecular physics; instrumentation and experimental techniques; and omniana. (RWR)

For title-listing of individual papers see: 11814–11818, 11835, 11836, 11845, 11854–11856, 11864, 11879, 11887, 11897–11901, and 11920–11922.

11814 (ORNL-4844, pp 10-17) PREDICTED INTERMEDIATE STRUCTURE IN HIGH-RESOLUTION DEEP-HOLE SPECTRA. Becker, R. L. Apr 1973.

Physics division annual progress report for period ending December 31, 1972.

11815 (ORNL-4844, pp 38-39) SEARCH FOR A ^{3}He + ^{3}He RESONANCE IN ^{6}Be; ASTROPHYSICAL IMPLICATIONS. Halbert, M. L.; Hensley, D. C.; Bingham, H. G. Apr 1973.

Physics division annual progress report for period ending December 31, 1972.

11816 (ORNL-4844, pp 39-42) ISOSPIN CONSERVATION IN COMPLICATED REACTIONS. Goodman, C. D.; Hensley, D. C.; van der Woude, A.; Raman, S. Apr 1973.

Physics division annual progress report for period ending December 31, 1972.

11817 (ORNL-4844, pp 45-46) HEAVY-ION NEUTRON YIELDS. Bair, J. K.; Dress, W. B.; Johnson, C. H.; Stelson, P. H. Apr 1973.

Physics division annual progress report for period ending December 31, 1972.

11818 (ORNL-4844, pp 50-54) $^{10}B(^{16}O,d)$, $^{10}B(^{16}O,\alpha)$, AND $^{12}C(^{16}O,\alpha)$ REACTIONS. Ford, J. L. C. Jr. (Oak Ridge National Lab., TN); Gomez del Campo, J.; Thornton, S. T.; Robinson, R. L.; Stelson, P. H. Apr 1973.

Physics division annual progress report for period ending December 31, 1972.

11819 ELECTROMAGNETIC CORRECTIONS IN COULOMB DISPLACEMENT ENERGIES. Gomez, J. M. G.; Sesma, J. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Lett.; 44B: No. 3, 231-234(30 Apr 1973).

It is shown that the relativistic electromagnetic corrections provide a simple explanation of the systematic deviations of the Coulomb energy shifts in double odd self-conjugate nuclei. General expressions of the form of the interactions are given. (auth)

11820 SPECTROSCOPIC FACTORS FOR THE ^{11}B 6.76-MeV LEVEL USING REALISTIC OPTICAL-MODEL POTENTIALS. Comsan, M. N. H. (Atomic Energy Establishment, Inshas, Egypt). Atomkernenergie; 21: No. 1, 41-43(1973).

Spectroscopic factors of the 6.76-MeV excited state in ^{11}B were obtained using realistic parameters for the optical potentials. Spectroscopic factors were deduced from the DWBA analysis of the $^{10}B(d,p_4)^{11}B^*$ reaction at ten deuteron energies from 0.67 to 2.32 MeV. The average value of the spectroscopic factors over the energy range was found to be $0.99^{+0.16}_{-0.08}$, in excellent agreement with shell-model predictions. (3 figures, 2 tables) (auth)

11821 POSSIBLE RELATIVISTIC EFFECT IN (p,2p) REACTION ON LIGHT NUCLEI. Maric, Z. (Inst. of Physics, Belgrade); Suslenko, V. C. Fizika (Zagreb); 5: No. 1, 43-47(Mar 1973).

A recent experiment has indicated that the momentum of the recoil nucleus can be very high up to at least 600 MeV/c. Thus, it may be that relativistic effects change considerably the overall energy–momentum conservation law of the incident-intranuclear proton system that undergoes the collision, and it is this effect that is discussed. After derivation of the general expressions, the dependence of the kinetic energy of the outgoing particles on the angle of detection is plotted for the reaction $^9Be(p,2p)^8Li$ at T = 600 MeV. It is shown that the effect is connected with the momentum and kinetic energy of the proton inside the initial nucleus. It is concluded that, in the framework of the impulse approximation, the relativistic effect of overall kinetic energy increase in (p,2p) reactions can be measured by detecting the greater values of the kinetic energy of the outgoing particles at large angles, accessible in a symmetric coplanar experiment. (3 figures) (RWR)

11822 ELECTROEXCITATION FORM FACTORS AND FIXED MULTIPOLARITY SUM RULES. Deal, T. J.; Fallieros, S. (Brown Univ., Providence). Phys. Lett.; 44B: No. 3, 224-226 (30 Apr 1973).

Sum rules are derived for form factors describing the longitudinal isoscalar electroexcitation of nuclear levels with definite multipolarity. The sum-rule limits are not constant numbers but functions of the momentum transfer. Their behavior for small and large momentum transfers is discussed. An application is also presented for the excitation of the first-excited state of ^6Li by inelastically scattered electrons. (auth)

11823 INCOHERENT PROCESS $\pi^- + A \rightarrow 2\pi^-\pi^+ + A^*$. Reaction with Quasifree Neutrons of a Nucleus. Protasov, V. P.; Sergeev, F. M. (Moscow Engineering-Physics Inst.). Yadern. Fiz.; 17: No. 5, 926-934(May 1973). (In Russian).

The generation is studied of the $2\pi^-\pi^+$-meson triplet on quasifree neutrons of light nuclei (C, F, Cl) by the 3.9-GeV/c π^--mesons. The reaction channels with ρ^0-meson, N*(1238)-isobar and A_2-meson production are analyzed. The observed asymmetry of the ρ-meson decay is due to the reaction mechanisms leading to the "leader" production. It is shown to be principally possible to verify experimentally the A_2-meson-nucleon interaction cross section from the incoherent part of the nuclear reaction. The possible use of the reaction of particle production on light nuclei for the investigation of the reduced widths of nuclear transitions is demonstrated. (auth)

11824 STUDY OF THE DECAY OF THE ^8He NUCLEUS FROM THE TRIPLE FISSION OF ^{235}U INDUCED BY THERMAL NEUTRONS. Andreev, V. N.; Nedopekin, V. G.; Rogov, V. I. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 5, 897-900(May 1973). (In Russian).

The ^8He ions were detected by means of the ionization chamber which gives the values of ΔE, E and the ion range. The energy and the decay time of each stopped ion were measured. Only decays accompanied by production of light nuclei with more than 1 MeV energy were registrated. The probability of the decay $^8He \rightarrow {}^8Li \rightarrow {}^8Be \rightarrow 2\alpha$ is determined to be 0.88 ± 0.08. The decay energy and time spectra are also presented. The upper limits are obtained of the decay probabilities for Be, B, C produced in the triple fission of ^{235}U. (auth)

11825 EXCITATION OF THE ^{16}O LEVELS BY HIGH ENERGY PROTONS. Goryachev, Yu. M.; Kanavets, V. P.; Kirpichnikov, I. V.; Levintov, I. I.; Morozov, B. V.; Nikiforov, N. A.; Starostin, A. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 5, 910-915(May 1973). (In Russian).

The spectra of γ-rays emitted by the ^{16}O nucleus bombarded by protons with T_p = 1.0, 2.9 and 6.3 GeV energies were studied. (auth)

11826 EXPERIMENTAL STUDY OF THE MECHANISM OF THE REACTION $^6Li(\pi^-,\pi^-p)^5He$. Bayukov, Yu. D.; Vorob'ev, L. S.; Kolybasov, V. M.; Leksin, G. A.; Stolin, V. L.; Fedorov, V. B.; Khovanskii, V. D. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 5, 916-925(May 1973). (In Russian).

From 2500 events the detailed data on the $^6Li(\pi^-,\pi^-p)^5He$ reaction at small momentum transfer $q < 170$ MeV/c (to the residual nucleus) were obtained. The absolute values of the cross sections, angular and momentum distributions of the reaction products, angular and momentum correlations of the πp-system are found for different q regions. Besides that, the momentum spectrum at 20° is measured for π^- mesons scattered by the ^6Li nucleus (without discrimination of the final states). The analysis of the data was made in order to estimate quantitatively the relative contributions to the $^6Li(\pi^-,\pi^-p)^5He$ reaction from different mechanisms. (auth)

11827 HYPERNUCLEAR BINDING ENERGIES IN THE α-PARTICLE MODEL. Rayet, M. (Univ., Brussels). Nucl. Phys.; B57: No. 1, 269-291(1973).

The binding energies B_Λ for the hypernuclei with baryon number $A = 4N + 1$ up to $\Lambda^{25}Mg$ have been calculated by the variational method in the framework of Brink's α-particle model. The central ΛN potential is adjusted to the binding energy of $^5_\Lambda He$. Due to their strong dependence on the nuclear density, the B_Λ energies are very sensitive to the choice of the effective nuclear interaction and have reasonable values for large A with the potential B1 of Brink and Boeker. The comparison with the B_Λ values obtained in the limiting shell model and the consideration of two different Λ-particle wave functions both indicate that the effect of nuclear clustering on B_Λ is significant only for $^9_\Lambda Be$ and $^{13}_\Lambda C$. The nuclear distortion due to the Λ-particle binding is also evaluated in this calculation. (auth)

11828 DIRECT EXPERIMENTAL TEST OF THE COEXISTENCE MODEL FOR THE STRUCTURE OF THE GIANT DIPOLE RESONANCE IN ^{16}O. Goswami, A.; Graves, R. D. (Univ. of Oregon, Eugene). Phys. Lett.; 44B: No. 4, 335-337(14 May 1973).

A direct experimental test of the recently proposed coexistence model for the structure of giant dipole resonance in ^{16}O is discussed. (auth)

11829 CHARGED PION PHOTOPRODUCTION FROM ^{12}C WITH EXCITATION OF ANALOG STATES. Uberall, H. (Catholic Univ. of America, Washington, DC); Lamers, B. A.; Lucas, C. W.; Nagl, A. Phys. Lett.; 44B: No. 4, 324-326(14 May 1973).

Differential cross sections of $\pi^+(\pi^-)$ photoproduction near threshold on a ^{12}C target with excitation of the $^{12}B(^{12}N)$ analog levels are calculated. Charged pion photoproduction excites predominantly the spin flip states, so that such an experiment may determine the degree of spin flip strength of the $\Delta T = 1$ levels. (auth)

11830 THEORETICAL STUDY OF CORE-POLARISATION EFFECTS ON E2 TRANSITIONS IN MASS-19 NUCLEI AND IN THE $^{19}F(p,p')^{19}F$ REACTION. Perez, S. M. (Univ. of Cape Town, Rondebosch, South Africa); Benson, H. G. Nucl. Phys.; A208: No. 3, 449-462(1973).

First-order core-polarization corrections are applied to full intermediate-coupling wave functions of the mass-19 system in a calculation of E2 transition rates. The theoretical E2 strengths are found to be smaller than those measured experimentally by a factor which varies between about 1 and 2 depending on the particular transition. The calculation is performed by first calculating a set of spectroscopic amplitudes which contain all the "one-body" information of the nuclear states. The same spectroscopic amplitudes are used in a DWBA calculation of the $^{19}F(p,p')^{19}F$ reaction in which the effective density-dependent interaction of Pandhari-

pande is used for the projectile target-nucleon interaction. The importance of using fully antisymmetrised DWBA matrix elements and also of including core-polarization effects are clearly evident. Excellent theoretical fits for angular distributions of inelastically scattered protons from the lowest members of the ground-state rotational band are obtained. The theoretical cross sections must be normalized by similar factors to those required to bring the calculated E2 transition strengths into agreement with experiment, thus indicating the suitability of the interaction used. (auth)

11831 Q-VALUES AND EXCITATION FUNCTIONS OF NUCLEAR REACTIONS. Part B. Excitation Functions for Charged Particle Induced Nuclear Reactions. Keller, K. A.; Lange, J.; Muenzel, H.; Pfennig, G. Landolt Boernstein. Numerical Data and Functional Relationships in Science and Technology. New Series. Group I. Nuclear and Particle Physics. Volume 5. Berlin; Springer-Verlag (1973). 499p. (In English and German). $91.80.

Tables and curves are presented for Q-values for nuclear reactions, excitation functions for charged-particle-induced nuclear reactions, and systematics of excitation functions for nuclear reactions induced by protons, deuterons, helium-3, and alpha particles. (JFP)

11832 DENSITY-DEPENDENT EFFECTIVE INTERACTIONS IN FINITE NUCLEI. II. Fai, G. (Roland Eoetvoes Univ., Budapest); Nemeth, J. Nucl. Phys.; A208: No.3, 463-476(1973).

The effect of the density dependence of the effective forces on spherical nuclear calculations is examined. Calculations were made with forces giving different nuclear matter saturation densities and compressibilities and also with interactions having different long-range density dependence. The results were compared with experiments. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 11793, 11813, 11819, 11823, 11827, 11831, 11846, 11863, 11869, 11874, and 11918.

11833 (COO-3494-5, pp 13-25) FUSION BARRIER HEIGHTS/ELASTIC SCATTERING. Gutbrod, H. H.; Winn, W. G.; Blann, M. 1973.

In nuclear reaction mechanisms.

Counter telescopes were used to measure fusion product, fission, transfer, and elastic scattering and cross sections for sulfur-32 reactions with magnesium-24, aluminum-27, calcium-40, and nickel-58. Fusion barrier heights and radii for fusion reactions are also found. It is concluded that 90 ± 10% of the total reaction cross section is to be found in the fusion cross section for these systems and in the energy range investigated, that is, 70 to 120 MeV. (JFP)

11834 (FRNC-TH-308) STUDY OF SEVERAL NUCLEON EXCITATION IN ^{20}Ne AND ^{24}Mg NUCLEI USING (^{14}N,^{6}Li) REACTIONS. Volant, C. (Paris Univ. (France)). 1972. 91p. (In French). NTIS (U. S. Sales Only).

Thesis.

The mechanism of the following reactions was studied: ^{12}C(^{14}N,^{6}Li)^{20}Ne; ^{16}O(^{14}N,^{6}Li)^{24}Mg. The observed results indicate that a direct transfer mechanism involving eight nucleons is the most dominant process involved in these reactions. In spite of the fact that a theoretical analysis of these reactions is not yet possible, it is shown that comparative studies of the spectra of a residual nucleus involving the transfers of 4 and 8 nucleons enable information to be obtained on the nucleon structure of the excited states. It was possible to establish the existence of some ^{20}Ne states having configurations implicating the opening of the ^{16}O core: in particular, several levels with 2 quartets-1 quartet hole were localized between 7 and 9 MeV excitation energies. It was also possible to demonstrate that the wave functions of the $K = 0^+$ and $K = 2^+$ rotation bands of ^{24}Mg overlap very little with the alpha ^{20}Ne configuration. Because of the fact that these bands are strongly excited by the ^{16}O(^{14}N,^{6}Li)^{24}Mg reaction, their intrinsic structures are of the same form as ^{16}O clusters. In order to exactly define the nature of these clusters (^{8}Be, two free or correlated alpha particles etc. . .) it is necessary to know their weight in the wave function of the ^{14}N projectile. (FR)

11835 (ORNL-4844, pp 47-49) NEUTRON TOTAL CROSS SECTIONS FOR KILOVOLT NEUTRON ENERGIES. Good, W. M.; Harvey, J. A. Apr 1973.

Physics division annual progress report for period ending December 31, 1972.

11836 (ORNL-4844, pp 61-67) ELASTIC SCATTERING OF HELIONS AND ALPHA PARTICLES AT AND NEAR 180°. Eidson, W. W. (Drexel Univ., Philadelphia); Foster, C. C.; Fulmer, C. B.; Hafele, J. C.; Hensley, D. C.; O'Fallon, N. M. Apr 1973.

Physics division annual progress report for period ending December 31, 1972.

11837 γ-DECAY OF ^{25}Mg. Roepke, H.; Glattes, V.; Brundiers, H. J.; Hammel, G. (Univ., Freiburg i. B.). Z. Phys.; 260: No. 1, 67-74(1973).

The reactions ^{24}Mg(d,pγ) and ^{27}Al(d,αγ) have been used to study the main γ-decay modes of all bound and several unbound levels in ^{25}Mg up to E_x = 8,574 keV. The relevance of the data with respect to the rotational model is discussed. (3 figures, 1 table) (auth)

11838 STUDY OF THE ^{35}Cl(d,p)^{36}Cl REACTION AT LOW DEUTERON ENERGIES. El-Behay, A. Z.; Comsan, M. N. H.; Farouk, M. A. (Atomic Energy Establishment, Inshas, Egypt). Atomkernenergie; 21: No. 1, 44-47(1973).

Excitation functions and angular distributions of the ^{35}Cl(d,p)^{36}Cl reaction were measured for transitions to the six lowest states of ^{36}Cl in the deuteron energy range from 1.68 to 2.50 MeV. The experimental data were analyzed on the basis of Ericson's fluctuation theory. An average level width for the compound nucleus, ^{37}Ar, at excitation energies in the region of 17 MeV was found to be (16.8 ± 3.5) keV. Values of 2^+ and 1^+ are suggested for the spins of the 0.788-MeV and 1.598-MeV levels of ^{36}Cl. (7 figures, 2 tables) (auth)

11839 DETERMINATION OF THE (μ^-,ν2n)-REACTION PROBABILITY FOR μ^--CAPTURE IN SULPHUR AND CALCIUM. Evseev, V. S.; Roganov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 5, 1012-1016(May 1973). (In Russian).

The absolute capture probability (per a μ^--capture event) for the (μ^-,ν2n) reaction in ^{32}S and ^{40}Ca is measured by activation method. Comparing the obtained results with the predictions of different μ^--capture models and with other experimental data it is concluded that the muon absorption by nuclear clusters (quasi-deuteron) can not be the main source of high energy part of the nucleon spectra in the reaction. (auth)

11840 SYSTEMATIC OPTICAL-MODEL ANALYSIS OF DEUTERON SCATTERING FROM ^{24,26}Mg AND ^{28,30}Si. Schneck, B.; Hofmann, A. (Erlangen-Nuernberg Univ., Erlangen, Ger.). Z. Phys.; 260: No. 1, 35-45(1973). (In German).

Differential cross sections were measured for 10-MeV deuterons elastically scattered from ^{24,26}Mg and ^{28,30}Si. The scattering data were analysed systematically in the framework of the optical model. It was found that a uniform set of parameters which is able to reproduce reasonably the angular distributions for the four nuclei does not exist. Both the Mg distributions as well as both the Si distributions, however, can be described well with one set of parameters. (5 figures, 2 tables) (auth)

11841 PARTICLE-HOLE NATURE OF THE TWO LOWEST 3-STATES IN ^{24}Mg. Tribble, R. E.; Garvey, G. T.; Comfort, J. R. (Princeton Univ., NJ). Phys. Lett.; 44B: No. 4, 366-369(14 May 1973).

Stripping and pickup reactions are performed and the configuration for the lowest 3^- state (7.62 MeV) is shown to be mainly a hole in the 1p shell while the next 3^-level (8.36 MeV) is mainly a particle promoted into the 2p-1f shell. (auth)

11842 INELASTIC NEUTRON SCATTERING BY ^{56}Fe AND ^{31}P IN THE ENERGY RANGE 0.8 TO 9.0 MeV. Kellie, J. D.; Islam, M. N.; Crawford, G. I. (Univ. of Glasgow). Nucl. Phys.; A208: No. 3, 525-544(1973).

Cross sections for the production of de-excitation γ-rays following inelastic neutron scattering were measured for ^{56}Fe and ^{31}P from threshold to 9.0 MeV. For ^{56}Fe the 0.845, 1.24 and 1.81 MeV γ-rays were observed. For ^{31}P the 1.266 and 2.234 MeV γ-rays were observed. Multiple scattering effects in disk and toroidal geometries are discussed. The experimental results are compared with the values calculated using the Hauser-Feshbach formula modified by the Moldauer width fluctuation correction. (auth)

11843 DETERMINATION OF ^{27}Al(p,α)^{24}Mg REACTION TIMES WITH THE BLOCKING EFFECT. Nakayama, H. (Tokyo Inst. of Tech.); Ishii, M.; Hisatake, K.; Fujimoto, F.; Komaki, K. Nucl. Phys.; A208: No. 3, 545-556(1973).

The reaction times for the ^{27}Al(p, α)^{24}Mg reaction at four resonances were measured by the blocking effect technique. A ≈ 1 mm thick Al single crystal was used as a target. By comparing the reduction in the area of the {111} planar blocking dip with the theoretical value, the reaction times at the E_p = 633, 731, 937 and

1183 keV resonances were determined to be 135 ± 20, 59 ± 8, 11 ± 8 and ≲ 14 as, respectively. These reaction times are consistent with previously reported resonance widths. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 11387, 11388, 11806, 11819, 11831–11833, 11835, 11836, 11839, 11842, 11856, 11863, 11874, 11918, 11930, and 11933.

11844 (INS–583) PROGRESS REPORT 19, JANUARY–JUNE 1972. (Institute of Nuclear Sciences, Lower Hutt (New Zealand)). Jan 1973. 110p. Dep. NTIS (U. S. Sales Only) $7.50.

The work of the Institute during the first half of 1972 is briefly summarized in this document, which is basically administrative in nature. The broad areas covered include the following: nuclear physics, radiation research, isotope geochemistry–stable isotopes, radioactive dating and fallout, radioisotope applications and atmospheric trace gases, instrumentation, and theoretical physics. Data are presented on the $^{54}Fe(p,\gamma)^{55}Co$ reaction and radioactive fallout. (9 figures, 4 tables) (RWR)

11845 (ORNL-4844, pp 67-69) TOTAL CROSS SECTION OF CALCIUM. Johnson, C. H.; Fowler, J. L.; Hill, N. W. Apr 1973.

Physics division annual progress report for period ending December 31, 1972.

11846 (ORO-1067-10) ANNUAL PROGRESS REPORT. Newson, H. W. (Duke Univ., Durham, N. C.). 31 Dec 1972. Contract AT(40-1)-1067. 102p. Dep. NTIS $7.25.

This report consists of two semiannual progress reports submitted to the U. S. Nuclear Data Committee. The work covers the broad areas of neutron and fission physics, charged-particle reactions, development, and theory. The items in this report are very brief (a fraction of a page) descriptions of work, much of which has been or will be published. (RWR)

11847 (RCN–184) INVESTIGATION OF THERMAL-NEUTRON CAPTURE IN ^{39}K. Op den Kamp, A. M. F. (Reactor Centrum Nederland, The Hague). May 1973. 58p. Dep. NTIS (U. S. Sales Only) $5.00.

An investigation of states in ^{40}K, which are excited in the (n,γ) reaction is described. The neutrons are extracted from the High Flux Reactor at Petten, The Netherlands. For the measurements of the single spectrum, of gamma–gamma coincidences and of gamma–gamma angular correlations, Ge(Li) and NaI detectors were used. A neutron filter consisting of one bismuth and four quartz single crystals was used to decrease the fast neutron component in the neutron beam. In the $^{39}K(n,\gamma)$ reaction 222 gamma transitions were found of which 187 could be fitted into the level scheme of ^{40}K. The energies of 54 states in ^{40}K and the reaction Q value were determined, the latter is Q = 7799.7 ± 0.8 keV. Polarized neutrons were obtained with a magnetic mirror system. The coherent interference of the two spin components in the capture state, after capture of polarized thermal-neutrons, was proved. The results of this investigation are combined with those of the angular correlation experiment which resulted in $J^\pi = 3^-$, 2^-, 2^- and 2^- for the states at 0.03, 0.80, 2.05 and 2.42 MeV, respectively. Spin restrictions to the states at 2.10, 3.44 and 4.25 MeV were also made. The multipole mixing ratios of the gamma transitions which deexcite the levels mentioned, are determined. (auth)

11848 SPECTROSCOPIC STUDY OF MULTINUCLEON TRANSFER REACTIONS INDUCED BY HEAVY IONS. Lemaire, M. C. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Rep.; 7C: No. 6, 279-336(Apr 1973).

After a brief introduction, a theoretical description of four-nucleon correlations is given touching on calculations based on deformed orbits, shell-model calculations, the alpha-particle model, and the stretch scheme. Experimental results are then addressed; experimental procedure, typical examples of the selectivity of the two- and four-nucleon-transfer reactions, and experimental study of the reaction mechanism are examined. A semiclassical description of the experimental data is given for elastic scattering and the $^{54}Fe(^{16}O, ^{12}C)^{58}Ni$ reaction. The discussion then turns to the DWBA formalism for multinucleon-transfer reactions induced by heavy ions; aspects considered are the DWBA treatment of multinucleon transfer based on the Talmi–Moshinsky technique, DWBA formalism of Bonche and Giraud, kinematical factors for transfer reactions induced by heavy ions, and nuclear spectroscopy with multinucleon-transfer reactions. The DWBA formalism is then applied: optical-model analysis of the $^{54}Fe(^{16}O, ^{16}O)^{54}Fe$ and $^{58}Ni(^{12}C, ^{12}C)^{58}Ni$ angular distributions, DWBA analysis of the transfer angular distributions, and possible improvement of the DWBA analysis of transfer induced by heavy ions. After a discussion of experimental spectra, the author summarizes his conclusions. (32 figures, 7 tables, 79 references) (RWR)

11849 MICROSCOPIC MODEL OF INELASTIC DEUTERON SCATTERING FROM ^{39}K NUCLEI. Budzanowski, A.; Grotowski, K.; Kobos, A.; Strzalkowski, A. (Inst. of Nuclear Physics, Krakow). Phys. Lett.; 44B: No. 3, 249-251(30 Apr 1973).

A microscopic analysis of the $^{39}K(d,d')$ scattering at 12.8 MeV to the 2.526 MeV excited state with realistic direct, exchange and Coulomb terms of an effective d–N interaction and mixed microscopic and collective analysis for excitation of 2.817 MeV state are presented. (auth)

11850 INTERFERENCE EFFECTS IN ELASTIC AND INELASTIC HEAVY ION SCATTERING. Malfliet, R. A.; Landowne, S.; Rostokin, V. (Univ. of Copenhagen). Phys. Lett.; 44B: No. 3, 238-240(30 Apr 1973).

It is shown that if oscillations in the forward angular distribution of elastically scattered heavy ions are due to the nuclear ion–ion potential, there will be corresponding oscillations in the inelastic angular distributions which are phase shifted by 180° from those in the elastic scattering. (auth)

11851 STUDY OF THE GAMMA-RAY DECAY FROM THE ^{52}V GROUND STATE ISOBARIC ANALOG RESONANCE. Faini, G. J. Athens, GA; Univ. of Georgia (1972). 120p. University Microfilms Order No. 63-5690.

Thesis (Ph. D.).

The gamma-ray decay of the isobaric analog of the ^{52}V ground state was studied via the $^{51}V(p,\gamma)^{52}Cr$ reaction. Natural vanadium targets of approximately 7 $\mu g/cm^2$ thickness were bombarded with a proton beam produced by the University of Georgia Van de Graaff accelerator, and the emitted gamma rays were observed with a 60-cm^3 Ge(Li) detector. The gamma-ray yield was measured for $745 < E_p$ (lab) < 820 keV with an energy resolution of less than 3 keV. Relative intensities and decay schemes of four of the resonances observed in the yield curve were obtained for E_p = 766, 774, 783, and 800 keV. The isobaric analog of the ^{52}V ground state was identified as a level in ^{52}Cr with $E_x = 11.259 + 0.005$ MeV corresponding to the resonance at 774 keV. Angular distributions for four of eight gamma rays decaying from the isobaric analog state were measured; and their E2/M1 mixing ratios, determined. The relative transition rates for the decay of the analog to the $2^+_{1,2}$ and $4^+_{1,2}$ states in ^{52}Cr were compared with the log-ft values for the corresponding beta decay of ^{52}V; good agreement was obtained for three of the four states. A shell-model description of the states in ^{52}Cr, which excluded neutron particle-hole excitations, was used to calculate gamma-ray transition probabilities and E2/M1 mixing ratios. Comparison with experimental results indicates that the assumed model of the isobaric analog state is dominated by the configuration of an inert ^{48}Ca core coupled to three $1f_{\frac{7}{2}}$ protons and one $2p_{\frac{3}{2}}$ proton. (Diss. Abstr. Int., B)

11852 ELASTIC AND INELASTIC SCATTERING OF VECTOR POLARIZED DEUTERONS BY Fe AND Ni ISOTOPES. Brown, R. C.; Debenham, A. A.; Griffith, J. A. A.; Karban, O.; Kocher, D. C.; Roman, S. (Univ. of Birmingham, Eng.). Nucl. Phys.; A208: No. 3, 589-610(1973).

Vector analyzing powers and cross sections for deuteron elastic and inelastic scattering by $^{54, 56, 58}Fe$ and ^{60}Ni were measured at a deuteron energy of 12.3 MeV. Large changes in the elastic scattering analyzing power were observed for small changes in the target mass. The elastic data are well described by standard optical model calculations employing fixed real and spin-orbit geometry parameters. The analysis yielded a spin-orbit potential depth of about 6.5 MeV and a volume integral of the real central potential of about 365 MeV · fm^3 per nucleon for each nucleus. The variations of the measured analyzing powers with the target nucleus are explicable in terms of a dependence of the strength of the imaginary potential upon the neutron excess $(N - Z)/A$. The data for the 2^+ first-excited states are adequately described by a collective model analysis using both DWBA and coupled-channels formalisms. The coupled-channels treatment revealed a strong dependence of the predicted elastic and inelastic analyzing powers on the mode of excitation and the magnitude of the deformation parameter. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 11813, 11817, 11831, 11836, 11852, 11863, 11873, 11874, 11894, 11914, and 12076.

11853 (JINR-P15-7072) γ-DECAY OF ^{61}Cu ANALOG RESONANCES. Kraft, O. E.; Lebedev, P. P.; Naumov, Yu. V.; Sizov, I. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 19p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Gamma spectra from the decay of isobaric analog resonances (IAR) were measured for the reaction ^{60}Ni(p,γ)^{61}Cu. Fine-structure components were observed for $p_{\frac{1}{2}}$ IAR at E_p = 1599, 1605, and 1620 keV, for $f_{\frac{7}{2}}$ IAR at 1674 keV, and for $p_{\frac{3}{2}}$ IAR at 1856 keV. Anticorrelations were observed between the intensities of transitions to the ground and low-lying excited states for the $p_{\frac{1}{2}}$ IAR. From analysis of relations between ft and B(M1) values, as well as of transitions of analog–antianalog type, conclusions were reached about the essential effect of the spin–isospin pairing interaction. (2 figures, 3 tables). (auth)

11854 (ORNL-4844, pp 56-57) $^{63-65}$Cu(n,n'γ) REACTIONS. Slaughter, G. G.; Morgan, G. L.; Dickens, J. K. Apr 1973.

Physics division annual progress report for period ending December 31, 1972.

11855 (ORNL-4844, pp 70-71) CROSS SECTIONS FOR THE ^{61}Ni, ^{63}Cu(^{16}O,X) REACTIONS. Robinson, R. L. (Oak Ridge National Lab., TN); Wells, J. C. Jr.; Kim, H. J.; Ford, J. L. C. Jr. Apr 1973.

Physics division annual progress report for period ending December 31, 1972.

11856 (ORNL-4844, pp 71-75) INTERPRETATION OF THE $^{58-60}$Ni(^{16}O,X) REACTIONS. Robinson, R. L.; Kim, H. J. Apr 1973.

Physics division annual progress report for period ending December 31, 1972.

11857 DETERMINATION OF THE GROSS SECTION OF PHOTODISINTEGRATION OF EMULSION NUCLEY BY 1 TO 4.5 GeV γ-QUANTA. Galstyan, J. A.; Zverev, A. M.; Mameev, V. V.; Martinrosyan, M. A. (Inst. of Physics, Erevan). Yadern. Fiz.; 17: No. 5, 906-909(May 1973). (In Russian).

The cross section of photodisintegration of emulsion nuclei by bremsstrahlung γ-quanta is measured. The photodisintegration cross section per nucleon is obtained to be $\sigma_\gamma = 170 \pm 14$ μb for the γ-quanta energy region 1.0 to 4.5 GeV. (auth)

11858 DIRECT PROCESS IN THE INELASTIC SCATTERING OF 14.4-MeV NEUTRONS ON THE Nb AND Co NUCLEI. Sal'nikov, O. A.; Saprykin, E. M.; Kotel'nikova, G. V.; Lovchikova, G. N.; Luk'yanov, A. A.; Fetisov, N. I. Yadern. Fiz.; 17: No. 5, 1001-1007(May 1973). (In Russian).

The mechanism of direct inelastic scattering of a neutron by separate bound nucleons of the target nucleus is proposed to describe some qualitative features of the energy behavior of the hard part of the spectra and the asymmetry in the angular distribution of inelastically scattered neutrons produced at different angles in the experiments on the Nb and Co nuclei. The results of the calculation describe approximately the hard part of the spectra. Extrapolation to the relatively low energy region allows one to extract an isotropic Maxwell's part of the spectrum and gives correct values of the (n,2n) cross section. (auth)

11859 PROMPT γ-RAY SPECTRA FROM THE RADIATIVE CAPTURE OF 14.1 MeV NEUTRONS IN Cu, Se, Br, In, AND I. Budnar, M.; Cvelbar, F.; Ivkovic, V.; Perdan, A.; Potokar, M. (Univ. of Ljubljana, Yugoslavia). Fizika (Zagreb); 5: No. 1, 37-42(Mar 1973).

Spectra of primary γ transitions to bound states from the 14.1-MeV neutron radiative capture process in natural targets of Cu, Se, Br, In and I are presented together with the corresponding integrated cross sections. Because of the spherical geometry of the experiment, spectra were integrated over a solid angle of 4π for Cu, Se, Br, and I and over 2π for In. The energy spread of the initial neutrons was 1.35 MeV. (5 figures, 1 table) (auth)

11860 NUCLEAR DATA SHEETS FOR A = 77. Urone, P. P. (State Univ. of New York, Stony Brook); Lee, L. L. Jr.; Raman, S. Nucl. Data, Sect. A; 9: No. 3, 229-271(Mar 1973).

The 1966 version of the Nuclear Data Sheets for A = 77 was revised on the basis of all experimental data received before January 1, 1973. Experimental data, detailed level schemes, and arguments for J^π assignments are presented. Two new isotopes, ^{77}Ga and ^{77}Rb, are now known to exist, while a third, ^{77}Zn, has been tentatively identified. A significant amount of new information is now available on the ^{77}Ge, ^{77}As, ^{77}Se, and ^{77}Br level schemes. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 10637, 10961, 11831, 11832, 11836, 11857–11859, 11895, and 11914.

11861 (CEA-CONF-2016) PROGRAM OF IRRADIATION: PI. Catalog of Spectra and Calculation of Irradiation Parameter. Bouvard, P.; Cance, M.; Genthon, J. P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 8 Jun 1971. 58p. (In French). (CONF-710663-1). Dep. NTIS (U.S. Sales Only) $5.00.

From conference of dosimetry group of Euratom; Cadarache, France (22 Jun 1971).

The irradiation program (PI) is used to calculate irradiation parameters for threshold reactions, irradiation damage, and for all other effects dependent on the distribution of neutron energies. In addition, a subprogram LECTUR to the PI program enables cross sections and differential fluxes to be calculated in a given energy range from the values obtained in other ranges. This program includes a catalogue of neutron spectra obtained for different types of reactors: D_2O, H_2O, or graphite reactors, and fast neutron reactors. It also includes the cross sections corresponding to the principal threshold reactions used to measure fast fluxes as well as some radiation damage cross sections. (FR)

11862 (IEA-22) NUCLEAR PHYSICS RESEARCH WITH THE I.E.A. REACTOR. Goldemberg, J. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Aug 1972. 16p. (In Portuguese). Dep. NTIS (U.S. Sales Only) $3.00.

A description is given of the experiments in nuclear physics made at the Instituto de Energia Atômica of São Paulo. These include studies in nuclear resonance, internal conversion of electrons, and photofission. (tr-auth) (11 figures, 2 tables)

11863 (JUL-914-DE) CATALOG OF Ge(Li)-γ-SPECTRA. Zaddach, G. (Kernforschungsanlage, Juelich (West Germany). Abt. Dekontamination). Jan 1973. 527p. (In German). Dep. NTIS (U. S. Sales Only) $28.50.

A catalog of gamma spectra for nuclides with half-lives greater than 2 minutes is presented. Both linear and logarithmic plots of the spectra are given, along with tables of gamma energies. (GE)

11864 (ORNL-4844, pp 82-83) NEUTRON SHELL STRUCTURE OF ^{145}Nd FROM (d,p) AND (α,^{3}He) REACTIONS. Bingham, C. R. (Univ. of Tennessee, Knoxville); Hillis, D. L.; Ball, J. B. Apr 1973.

Physics division annual progress report for period ending December 31, 1972.

11865 (RLO-2227-T-7-22, pp 33-38) NUCLEAR SPECTROSCOPIC STUDIES OF THE DECAY OF NEUTRON-RICH Sn NUCLEI. Nunnelley, L.; Loveland, W. Mar 1973.

In nuclear chemistry progress report.

11866 (UCRL-74743) SYSTEMATIC PROPERTIES OF THE GIANT RESONANCE: CURRENT STATUS. Bramblett, R. L.; Fultz, S. C.; Berman, B. L. (California Univ., Livermore. Lawrence Livermore Lab.). 4 May 1973. 11p. (CONF-730301-7). Dep. NTIS $3.00.

From international conference on photonuclear reactions and applications; Pacific Grove, California, USA (26 Mar 1973).

The outstanding systematic properties of the giant resonance for photonuclear reactions, as observed by using real photons from about 8 to 35 MeV, are summarized from the point of view of the experimentalist. The annihilation photon technique is described, and the hydrodynamic model is used to interpret the data. Selected results are discussed, and attention is turned in succession to area ratios for deformed nuclei, decay modes of the giant resonance, giant-resonance widths, giant-resonance energies, and sum rules. (15 figures) (RWR)

11867 NEUTRON HOLE STATES IN THE N = 81 NUCLEI. Heyde, K.; Brussaard, P. J. (Univ., Utrecht). Z. Phys.; 259: No. 1, 15-36(1973).

The energy spectra of the N = 81 nuclei were calculated by coupling the neutron single-hole motion to the quadrupole vibrations of the nuclear surface. The wave functions were used to calculate M1 and E2 moments. Gamma-ray branching ratios are extensively discussed and compared with the many experimental data on ^{135}Xe, ^{139}Ce, and ^{141}Nd. Also, spectroscopic factors for (p,d) reactions were calculated and compared with experimental single-neutron pick-up reactions. The excitation energy and the lifetime of the isomeric state $J^\pi = 11/2^-$, decaying by an M4 transition, were studied, in particular, in their dependence on the number of extra protons. The behavior of the centroid of the neutron single-hole energies as a function of the number of extra protons was calculated with a delta force for the neutron–proton interaction. (9 figures, 7 tables) (auth)

11868 LEVELS AND TRANSITIONS IN ^{136}Ba. Bargholtz, C.; Eriksson, L.; Gidefeldt, L.; Holmberg, L.; Stefansson, V. (Univ. of Stockholm). Z. Phys.; 260: No. 1, 1-7(1973).

Excited states of ^{136}Ba were studied in the beta decay of ^{136}Cs.

The gamma spectrum was measured with high-resolution and coincidence techniques. Several new transitions are suggested to be connected with two recently reported levels. Gamma–gamma directional correlations were performed in an attempt to determine the characteristics of these levels and to determine mixing ratios. The lifetime of the 2207.5-keV state was remeasured, and the lifetime of the 2140.5-keV state was measured for the first time. (1 figure, 4 tables) (auth)

11869 VREMENNAYA SPEKTROSKOPIYA ATOMNYKH YADER. (Time Spectroscopy of Atomic Nuclei). Begzhanov, R. B.; Akilov, F. S. Tashkent; Izdatel'stvo FAN Uzbekskoi SSR (1972). 320p.

This monograph describes a number of direct methods for measuring the lifetimes of excited nuclear states and gives a critical analysis of each method. The method of delayed coincidences and variants of treatment of the results are examined. The microwave method using radioactive sources and Coulomb excitation is discussed. Use of the Doppler method, recoil interval (separation), Doppler shift attenuation, and Doppler lines of γ radiation is considered. (88 figures, 3 tables, 364 references) (KSW)

11870 DISINTEGRATION ENERGY OF ^{113}Sn: WHY HAVE P_L/P_K MEASUREMENTS YIELDED INCORRECT VALUES. Raman, S.; Kim, H. J.; Walkiewicz, T. A.; Martin, M. J. (Oak Ridge National Lab., TN). Phys. Lett.; 44B: No. 3, 255-257 (30 Apr 1973).

The P_L/P_K method of determining the ϵ-capture decay energy fails badly in the case of ^{113}Sn. It is suggested that the discrepancies in the measured values may be due to variable amounts of 250 d ^{119m}Sn present in the 115 d ^{113}Sn samples. (auth)

11871 FIRST EXCITED STATE IN THE DOUBLY CLOSED-SHELL NUCLEUS ^{132}Sn POPULATED IN THE 0.12s β^--DECAY OF ^{132}In. Kerek, A.; Holm, G. B.; De Greer, L. E.; Borg, S. (Research Inst. for Physics, Stockholm). Phys. Lett.; 44B: No. 3, 252-254(30 Apr 1973).

A 0.12 ± 0.02 s beta activity assigned to the decay of ^{132}In and populating an excited state at 4041 ± 2 keV in the doubly-closed-shell nucleus $^{132}_{50}Sn_{82}$ was observed. This state is tentatively assigned to arise from the 3^- octupole vibration. (auth)

11872 NUCLEAR DATA SHEETS FOR A = 126. Auble, R. L. (Oak Ridge National Lab., TN). Nucl. Data, Sect. B; 9: No. 2, 125-155(Feb 1973).

Nuclear structure data available through December 1972 are compiled, and adopted level properties and decay schemes are presented. The first section of the compilation consists of drawings summarizing essentially all available reaction and radioactivity data. The second section, "Summary Sheets," contains adopted level properties and, where space permits, tabulated data upon which they are based. The third section, "Data Sheets," is used only for those nuclei requiring extensive data tabulations. (auth)

11873 INTERNAL CONVERSION COEFFICIENTS FOR MULTIPOLARITIES E1, . . . , E4, M1, . . . , M4. Hager, R. S.; Seltzer, E. C.; Dragoun, O.; Pauli, H. C.; Schmutzler, F.; Plajner, Z.; Schmutzler, F.; Trusov, V. F. Atomic and Nuclear Data Reprints. Volume 1. New York; Academic Press, Inc. (1973). 389p. $12.50.

Since 1968 the journal Nuclear Data Tables has published four articles on internal conversion which, taken together, present a complete set of values for the internal conversion coefficients. These are collected here, together with a table to help find L-subshell ratios. These tables provide coefficients for the shells K, L_1, L_2, L_3, M_1, M_2, . . . , M_5 for Z = 30 to 103; N_1, N_2, . . . , N_5 for Z = 60 to 100; and for the combined outer shells, N + O + . . . , for Z = 37 to 100. Each table covers all multipolarities through four except the high-energy, K-shell table, which covers only dipole and quadrupole radiation. To find the conversion coefficient for a given transition, therefore, interpolation or extrapolation usually needs be made only in energy. To help find values for any desired energy an interpolation program is presented. This program was used to find L-subshell ratios for L_1/L_2 and L_2/L_3, and these results are tabulated. The last set of tables give K- and L-shell values for Z = 16 to 99 for gamma energies up to 10 mc^2. (RWR)

11874 CHARGED-PARTICLE REACTION LIST, 1948–1971. McGowan, F. K.; Milner, W. T. Atomic and Nuclear Data Reprints. Volume 2. New York; Academic Press, Inc. (1973). 561p. $15.00.

This compendium on charged-particle reactions is a guide to experiments reported in the journal literature for the period from 1948 through June 1971. It consists of the material from four Reaction Lists that have already appeared in Nuclear Data Tables, but integrated so that all information on a specific reaction can be found in one place. Each published experimental article is listed under the target nuclei in the nuclear reactions which it treats. The following information is given after the reaction designation: the energy of the bombarding particle, a brief statement of the type of data to be found in the paper, and bibliographic information on the paper itself. Beginning July 1970, theoretical papers treating directly with the analysis of nuclear reaction data and results are included. References are also given to Coulomb excitation papers published between 1956 and June 1971. (RWR)

11875 DOUBLE K-SHELL IONIZATION IN THE DECAY OF ^{109}Cd(^{109m}Ag), ^{131}Cs, ^{137m}Ba, and ^{165}Er. Nagy, H. J. Columbia, MO; Univ. of Missouri (1972). 153p. University Microfilms Order No. 73-7064.

Thesis (Ph. D.).

Double K-shell ionization in electron capture and internal conversion was investigated in the decay of $^{109}_{48}$Cd($^{109m}_{47}$Ag), $^{131}_{55}$Cs, $^{137m}_{56}$Ba and $^{165}_{68}$Er by recording K_α x-ray–K x-ray coincidences between a high resolution Si(Li) x-ray detector and a NaI(Tl) detector. The probabilities per K capture for double K-shell ionization in the decay of $^{131}_{55}$Cs and $^{165}_{68}$Er were determined to be (1.3 ± 0.4) × 10^{-5} and (6.7 ± 3.9) × 10^{-6}, respectively. The probability per K internal conversion for double K-shell ionization in the 88-keV transition of $^{109m}_{47}$Ag was determined to be (1.4 ± 0.2) × 10^{-4}. A value of $<5 \times 10^{-4}$ was obtained for the 662-keV transition in $^{137m}_{56}$Ba. A shifted Ag K_α x-ray was found in the decay of $^{109m}_{48}$Cd($^{109m}_{47}$Ag) whose energy differed from the normal K_α x-ray energy by (357 ± 42) eV. This shifted K_α x ray is due to an essential lack of screening in the K shell as the first vacancy is filled. (Diss. Abstr. Int., B)

11876 ANGULAR CORRELATION MEASUREMENTS WITH ^{115m}Cd. Theile, F. W. Marburg, Ger.; Marburg Univ. (1971). 76p. (In German).

Thesis.

$\gamma\gamma$ angular correlation measurements on ^{115}In are reported. The angular distribution of all transitions of this nucleus has been recorded simultaneously by means of multiparameter analyses. An extended energy-level scheme is proposed. (GE)

11877 FINE STRUCTURE OF THE DELAYED PROTON SPECTRUM. Karnaukhov, V. A.; Bogdanov, D. D.; Petrov, L. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 5, 889-896(May 1973). (In Russian).

The fine structure of delayed proton spectra is interpreted in terms of statistical fluctuations related to the fluctuations of the β^+-transition matrix elements and those of relative proton widths of excited states. Formulas are given connecting the dispersion of relative intensity in the proton spectrum with the averaged characteristics of the process and the level density. The calculation satisfactorily agrees with the ^{111}Te experimental data. Fluctuations essentially exceeding those measured are predicted for ^{109}Te. (5 figures) (auth)

11878 COULOMB EXCITATION OF ^{127}I, ^{129}I, AND ^{133}Cs. Renwick, B. W.; Byrne, B.; Eastham, D. A.; Forsyth, P. D.; Martin, D. G. E. (Univ. of Liverpool). Nucl. Phys.; A208: No. 3, 574-588 (1973).

The de-excitation γ-ray spectra of ^{127}I, ^{129}I and ^{133}Cs were studied following Coulomb excitation with 6.0 to 11.0 MeV α-particles. The γ-ray energies, branching ratios and B(E2) values were determined, and angular distribution measurements were used to assign the spin value of $^{11}/_2$ to the 696 keV level in ^{129}I and the 633 keV level in ^{133}Cs. The results were compared with recent calculations based on the intermediate coupling unified nuclear model. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 11831, 11863, 11873–11875, 11887, and 11910.

11879 (ORNL-4844, pp 85-86) LIFETIME MEASUREMENTS OF 8^+, 10^+, AND 12^+ ROTATIONAL STATES IN ^{164}Dy. Hagemann, G. B. (Oak Ridge National Lab., TN); Eichler, E.; Hensley, D. C.; Johnson, N. R.; Milner, W. T.; Riedinger, L. L. Apr 1973.

Physics Division annual progress report for period ending December 31, 1972.

11880 SVOISTVA ATOMNYKH YADER. Vypusk 15. Izobarnye Yadra s Massovym Chislom A = 170. (Properties of Atomic Nuclei. Issue 15. Isobaric Nuclei with Mass Number A = 170).

Dzhelepov, B. S.; Shestopalova, S. A. Leningrad; Izdatel'stvo Nauka Leningradskoe Otdelenie (1973). 332p.

The properties of the isotopes ^{170}Ho, ^{170}Er, ^{170}Tm, ^{170}Yb, ^{170}Lu, ^{170}Hf, ^{170}Ta, ^{170}W, and ^{170}Os are presented; all experimental data on the stable and radioactive isotopes, nuclear masses, magnetic and electric moments, lifetimes of nuclear states, spectra of γ rays and conversion electrons, $\gamma-\gamma$ and $\gamma-e$ coincidences, and nuclear reactions which lead to excited states of the nuclei cited are compared. All available information on decay schemes of the radioactive nuclei ^{170}Ho, ^{170}Tm, ^{170}Lu, and ^{170}Hf were collected including a selection of quantum characteristics for each nuclear state. (75 figures, 94 tables, 459 references) (KSW)

11881 ALPHA DECAY OF NEUTRON-DEFICIENT ISOTOPES OF TUNGSTEN. Eastham, D. A.; Grant, I. S. (Univ. of Manchester, Eng.). Nucl. Phys.; A208: No. 1, 119-129(1973).

Three neutron-deficient isotopes of tungsten were produced by the reactions of ^{24}Mg on targets of ^{147}Sm and ^{144}Sm. They are ^{164}W, E_α = 5.153 MeV, $T_{1/2}$ = 6.3 s; ^{163}W, E_α = 5.385 MeV, $T_{1/2}$ = 2.5 s; and ^{162}W, E_α = 5.53 MeV, $T_{1/2}$ < 0.25 s. (6 figures) (auth)

11882 SVOISTVA ATOMNYKH YADER. Vypusk 10. Izobarnye Yadra s Massovym Chislom A = 174. (Properties of Atomic Nuclei. Issue 10. Isobaric Nuclei with Mass Number A = 174). Balalaev, V. A.; Dzhelepov, B. S.; Uchevatkin, I. F. Leningrad; Izdatel'stvo Nauka Leningradskoe Otdelenie (1971). 148p.

The most reliable information on the characteristic radiation, decay schemes, quantum characteristics, transitions, etc., was collected for the isotopes ^{174}Tm, ^{174}Yb, ^{174}Lu, ^{174}Hf, ^{174}Ta, ^{174}W, ^{174}Re, ^{174}Ir, and ^{174}Pt. (52 figures, 32 tables, 208 references) (KSW)

11883 NUCLEAR DATA SHEETS FOR A = 157. Tuli, J. K. (Univ. of Indiana, Bloomington). Nucl. Data, Sect. A; 9: No. 3, 273-318(Mar 1973).

Nuclear data for the mass-157 isobars are presented on the basis of new experimental information. Every effort was made to include all available data prior to July 1, 1972. With the exception of Tm and Lu, A = 157 nuclei have been reported for all elements with $62 \le Z \le 72$. For ^{157}Hf and ^{157}Yb the only information known is their half-lives and α-decay energies. The ground-state spin but not the parity of ^{157}Er is known with certainty; its level structure has been studied through heavy-ion reactions, and a tentative level scheme is given. The decay of the ^{157}Ho ground state has recently been studied in detail but there is no information available on its excited states. In ^{157}Dy, energy levels up to 1.2 MeV have been well established through β/ϵ decay; the J^π assignments for $E_x > 0.5$ MeV are, however, less certain. The higher members of various rotational bands in ^{157}Dy have recently been reported in (α,xn) reaction studies. The ^{157}Tb level scheme has been studied through the decay of ^{157}Dy and the (p,t) reaction. As have other Gd isotopes, ^{157}Gd has been studied extensively. Its level scheme has been constructed on the basis of β-decay and various reaction studies. The J^π assignments for most levels above 0.5 MeV are from reaction studies, and are based upon model-dependent arguments. A new activity ($T_{1/2}$ = 83 s) has recently been assigned to ^{157}Sm; it has been proposed that the 30-s activity previously identified is an isomer in ^{160}Eu. (auth)

11884 NUCLEAR DATA SHEETS FOR A = 181. Ellis, Y. A. (Oak Ridge National Lab., TN). Nucl. Data, Sect. B; 9: No. 4, 319-399(Apr 1973).

The available nuclear structure information for all nuclei with mass number A = 181 is presented. Experimental data and their evaluation; comparison with theory, where possible; and arguments for spin, parity, and Nilsson-state assignments are given. Inconsistencies and discrepancies are indicated. Level schemes for each of the A = 181 nuclei are presented first. Then, for each nucleus, are presented the experimental data, followed by a summary of γ-ray properties, level properties, and comments. All energies are given in MeV units. The adopted level and decay properties are based on data received before September 1972. Data received from that date up to March 1973 are added in proof. (auth)

11885 MEASUREMENT OF THE ELECTRIC QUADRUPOLE MOMENT OF THE 482 keV STATE OF ^{181}Ta BY THE TIME DIFFERENTIAL PERTURBED ANGULAR CORRELATION TECHNIQUE. Netz, G.; Bodenstedt, E. (Univ., Bonn), Nucl. Phys.; A208: No. 3, 503-513 (1973).

The electric quadrupole interaction of the 482-keV state of ^{181}Ta in an environment of metallic rhenium was investigated by time differential angular correlation measurements. For the field gradient calibration a recent observation of the quadrupole splitting of the 6.3 keV line of ^{181}Ta in the same environment was used. Adopting the quadrupole moment of the ground state which was derived from muonic X-ray data one obtains $Q_{1/2}$(482 keV) 2.51 ± 0.15b. A comparison of the intrinsic quadrupole moment Q_0 with that of the ground state revealed that the excited state is slightly less deformed: $Q_0(5/2^+)/Q_0(7/2^+) = 0.936 \pm 0.014$. A measurement of the temperature dependence between liquid nitrogen and room temperature showed that the electric quadrupole interaction remains essentially constant. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 11831, 11832, 11863, 11869, 11873, 11874, 11894, and 11918.

11886 (NP-19781) SPIN ASSIGNMENTS IN THE TRANSITIONAL NUCLEI ^{215}Po, ^{219}Rn, AND ^{223}Ra FROM ALPHA-GAMMA DIRECTIONAL CORRELATION MEASUREMENTS. Hesselink, W. H. A. (Technische Hogeschool, Delft (Netherlands)). 1972. 88p. Dep. NTIS (U. S. Sales Only) $6.50.

Thesis.

The isotopes ^{215}Po, ^{219}Rn, and ^{223}Ra are nuclei of the transition region between nuclei adequately described by the shell model and nuclei successfully explained by the Nilsson model. The decay schemes of these nuclei were studied by $\alpha-\gamma$ coincidence and directional correlation measurements. The anisotropy coefficients were used to assign spins to the ground states of ^{215}Po, ^{219}Rn, ^{223}Ra, and ^{227}Th and to almost all excited levels having α feedings > 1% in ^{215}Po, ^{219}Rn, and ^{223}Ra. Special attention was paid to perturbations of $\alpha-\gamma$ directional correlations due to interaction of the nucleus with its environment. An additional study was made on the perturbations of $\alpha-\gamma$ correlations in the decay of the nearby even-even nuclei ^{226}Th and ^{230}U. Strong perturbations were found both with the daughter nucleus recoiling into vacuum and into aluminium; moreover, the results in the latter case appeared to be dependent on the method of source preparation. In order to remove the influence of the perturbations on the $\alpha-\gamma$ directional correlations which involve intermediate states having half-lives > 10^{-10} s, a decoupling experiment using an external magnetic field of 1.5 Tesla was performed on ^{227}Th. A superconducting magnet was constructed to make this type of decoupling experiment possible. The ground-state spin 9/2 found for ^{215}Po is in agreement with the prediction of the nuclear shell model. The spins assigned to levels in ^{219}Rn do not show a clear relation to either the shell model or the Nilsson model. The existence of two rotational bands in ^{223}Ra, i.e., the $1/2^+$ [640] ground-state band and the $3/2^-$ [761] band on the 79.9 keV level, is confirmed by the spin assignments. The relative α-particle intensities and the $\alpha-\gamma$ directional correlation results show that L = 2 intensities in the favored α decay to the different levels of the $3/2^+$[631] band are uncommonly weak, this result indicating a limitation of the applicability of the Nilsson model at low excitation energies. (29 figures, 8 tables) (RWR)

11887 (ORNL-4844, pp 30-32) EVIDENCE FOR A NEUTRON HALO IN HEAVY NUCLEI FROM ANTIPROTON ABSORPTIONS. Bugg, W. M. (Univ. of Tennessee, Knoxville); Cohn, H. O.; Condo, G. T.; Hart, E. L.; McCulloch, R. D. Apr 1973.

Physics Division annual progress report for period ending December 31, 1972.

11888 STUDY OF FISSION OF ^{238}U AND ^{209}Bi NUCLEI BY E_p = 1 GeV PROTONS. Kotov, A. A.; Semenchuk, G. G.; Bochagov, B. A.; Gorshkov, B. L.; Kovshevnyi, G. G.; Reznik, V. R.; Solyakin, G. E. (Inst. of Nuclear Physics, Leningrad). Yadern. Fiz.; 17: No. 5, 950-956(May 1973). (In Russian).

Angular correlations of separation, mass and energy distributions of fragments of ^{238}U and ^{209}Bi nuclei fission are measured using the surface-barrier Si detectors of the synchrocyclotron of the Leningrad Institute for Nuclear Physics. The measurement of the spectra of angular distributions of the fission fragments emission made it possible to determine the values of the average momentum transfers $\langle p_{||} \rangle$ of nuclei remaining after the internuclear cascade. The values of $\langle p_{||} \rangle$ were found to be 320 ± 30 and 500 ± 40 MeV/c for ^{238}U and ^{209}Bi, respectively. The comparison of mass and energy distributions of fragments with the experimental data on the fission of given nuclei by E_p = 2.9 GeV protons allows one to make a conclusion on weak dependence of the fission parameters on the energy of incident particle. (auth)

11889 CROSS SECTION AND ANGULAR ANISOTROPY OF FISSION OF ^{238}U, ^{209}Bi, ^{208,206}Pb, AND ^{197}Au BY 70 TO 200 MeV PROTONS. Bychenkov, V. S.; Lomanov, M. F.; Obukhov, A. I.; Perfilov, N. A.; Shigaev, O. E.; Shimchuk, G. G.; Yakovlev, R. M. (Radium Inst., Leningrad). Yadern. Fiz.; 17: No. 5, 947-949 (May 1973). (In Russian).

The fission cross section and angular anisotropy were determined by bombarding the uranium, bismuth, isotopes of lead and gold by 70, 100, 155 and 200 MeV protons. The solid track detectors (glass) were used to registrate the fission fragments. The anisotropy of the angular distribution of fission fragments is shown to decrease with increasing proton energy from 70 to 200 MeV. (auth)

11890 NUCLEAR DATA SHEETS FOR A = 192. Schmorak, M. R. (Oak Ridge National Lab., TN). Nucl. Data, Sect. B; 9: No. 2, 195-228(Feb 1973).

The available experimental data pertaining to the nuclear structure of nuclei with A = 192 are compiled; the results from various decay and reaction measurements are compared and evaluated. Inconsistencies and discrepancies in the level schemes are discussed. Level properties, gamma-ray properties, and comments are presented following the data on the relevant nucleus. Level schemes for each of the A = 192 nuclei are presented first. Then, for each nucleus, are presented the experimental data followed by a summary of level properties, γ-ray properties, and compiler's comments. All data received before December 1972 have been included. (auth)

11891 NUCLEAR STRUCTURE STUDIES ON A = 211 ISOBARS. Rao, D. V. Amherst; Univ. of Massachusetts (1972). 109p. University Microfilms Order No. 73-6701.

Thesis (Ph.D.).

Aspects of interest to nuclear structure have been studied through directional correlation in the β-decay of ^{211}Pb and electromagnetic decay of ^{211}Bi. Shell model calculations were carried out for some A = 211 isobars in an attempt to understand these and other experimental data. The 970 keV β-transition in the decay of ^{211}Pb to the $^7/_2^-$ first excited state of ^{211}Bi and 540 keV β-transition to $^9/_2^-$ state in ^{211}Bi were investigated by measuring the directional correlation of these β-groups with 405 and 830 keV γ-rays respectively using a scintillation $\beta-\gamma$ coincidence spectrometer. The directional correlation coefficient A_2 for 970 keV β- 405 keV γ is found to be about -0.02 for β-energies above 550 keV. This and other available information indicate the most likely J^π assignment for ^{211}Pb to be $^9/_2^+$. For the 540 keV β-830 keV γ cascade the angular distribution is found to be symmetric ($A_2 = 0$). The $\gamma-\gamma$ angular correlation experiments were carried out for two cascades in ^{211}Bi, 405 keV γ- 430 keV γ, 405 keV γ- 704 keV γ. The multipole mixing ratios extracted from the results of these experiments agree well with Gorodetzky et al. The k-internal conversion coefficient experiment done for 405 keV γ-ray in ^{211}Bi gave the mixing ratio to be -1.29 ± 0.09 in agreement with the value -1.15 ± 0.19 obtained by Gorodetzky et al. Shell-model wave functions and energies are obtained for ^{211}Pb, ^{211}Bi and ^{211}Po in the basis $[\nu 2g_{9/2}]^n[\pi h_{9/2}]^{3-n}$. In ^{211}Bi the $2f_{5/2}$ proton orbital is also included for the case of paired neutrons. Electromagnetic and β-decay transition rates were calculated and compared with the experiment. The directional correlation results for the 970 β- 405 keV γ cascade in the decay ^{211}Pb were analyzed for β-decay matrix elements using the formulation of Morita and Morita. It is found that the data are very well explained by the Kotani parameters $x = 0.75 \pm 0.15$, $y = 33 \pm 7$ and $z = 1.30 \pm 0.40$. These results are in agreement with the expectations based on CVC theory and shell-model calculations. The ft value for the β-transition is also well reproduced by these matrix elements. The results of directional correlation for 540 keV β- 830 keV γ cascade in the decay of ^{211}Pb were analyzed in the same formulation, but the matrix elements were calculated using the shell-model wave functions. The symmetry of experimental angular distribution is well reproduced by the theory for $\Lambda_{CVC} \simeq 2.55$ and $\Lambda_0 \simeq \Lambda_{CVC}$. The same value of Λ_{CVC} is used in ft value calculations and in the analysis of 970 keV β- 405 keV γ angular correlation. The experimentally observed isomeric state in ^{211}Po at 1.45 MeV is reproduced in these calculations and a similar state in ^{211}Bi is predicted at about 1.17 MeV with $J = {}^{25}/_2$. However the electromagnetic properties of the 405 keV level in ^{211}Bi are not satisfactorily explained in this model. (Diss. Abstr. Int., B)

11892 NUCLEAR DATA SHEETS FOR A = 190. Schmorak, M. R. (Oak Ridge National Lab., TN). Nucl. Data, Sect. B; 9: No. 4, 401-433(Apr 1973).

The available experimental data pertaining to the nuclear structure of nuclei with A = 190 are compiled; the results from various decay and reaction measurements are compared and evaluated. Inconsistencies and discrepancies in the level schemes are discussed. Level properties and gamma-ray properties are presented. Level schemes for each of the A = 190 nuclei are presented first. Then, for each nucleus, are presented summaries of level properties and compilers' comments, followed by the experimental data and a reference list. Data received before April 1973 were included. (auth)

11893 CHARGE DENSITY DIFFERENCE BETWEEN ^{208}Pb AND ^{209}Bi. Sick, I. (Stanford Univ., CA). Nucl. Phys.; A208: No. 3, 557-573(1973).

Cross sections for elastic electron scattering from ^{208}Pb and ^{209}Bi were measured for momentum transfers q between 0.7 and 2.8 fm^{-1}. The results were used to determine the Bi charge density and the difference of the Bi and Pb charge distributions. The density difference is compared to the wave function of the additional $1h_{9/2}$ proton in ^{209}Bi both with and without consideration of core polarization effects. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 10637, 11813, 11831, 11862, 11863, 11873, 11874, 11886, 11888, 11889, 11922, and 12151.

11894 (DESY-73/4) MEASUREMENT OF DELBRUECK SCATTERING AND OBSERVATION OF PHOTON SPLITTING AT HIGH ENERGIES. Jarlskog, G.; Jonsson, L.; Pruenster, S.; Schulz, H. D.; Willutzki, H. J.; Winter, G. G. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar 1973. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

The differential cross section for Delbrück scattering was measured at photon energies between 1 and 7 GeV and scattering angles between 1 and 3 mrad on copper, silver, gold, and uranium targets. The results confirm the predictions of quantum electrodynamics, if the exchange of a very large numger of photons with the nucleus (Coulomb correction) is taken into account. At momentum transfers of a few MeV/c, the Coulomb correction for uranium results in a reduction of the cross section by a factor between 3 and 5 as compared to the prediction of lowest-order relativistic perturbation theory. (auth)

11895 (KFK-1770) STUDY OF THE DE-EXCITATION OF PRIMARY FISSION FRAGMENTS FROM THE NEUTRON-INDUCED FISSION OF ^{235}U. Khan, T. A.; Hofmann, D.; Horsch, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Apr 1973. 45p. Dep. NTIS (U. S. Sales Only) $4.25.

Two separate three-dimensional experiments have been performed in which the energies of coincident fragment pairs and gamma-rays or internal conversion electrons, emitted within approximately 1.6 nsec after the thermal-neutron-induced fission of ^{235}U, were recorded event by event. The fragment kinetic energies were used for mass identification. The self-consistency of the values of electron energy, gamma-ray energy and fragment charge, and its agreement with x-ray selection data, were used to identify the atomic number of the fragments. The analysis of the gamma-ray and conversion electron spectra has resulted in the assignment of many transitions to new isotopes as well as improvement in or confirmation of many assignments from the ^{252}Cf spontaneous fission data. Limited information on the multipolarities of the transitions in even nuclei is presented. The relative yield of electrons per fragment indicates softness to deformation in mass region 100-110. Data are presented supporting the assignment of a 193-keV transition as the 2^+ to 0^+ transition in ^{98}Sr. An examination of the 2^+ level systematics of neighboring even-even nuclei suggests a transition from vibrational to rotational behavior in the light fragments between neutron numbers 58 and 60. (9 figures, 4 tables) (auth)

11896 (KR-148) PROMPT NEUTRONS FROM FISSION. Skarsvag, K. (Institutt for Atomenergi, Kjeller (Norway)). Jan 1973. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

Experimental data for the velocity (or energy) and angular distributions of prompt neutrons from fission were reanalyzed within the framework of the equilibrium statistical model. The parameters found in least-squares fits and the corresponding values of derived quantities are tabulated. (auth)

11897 (ORNL-4844, pp 90-91) NEUTRON TOTAL CROSS SECTION OF ^{248}Cm AND ^{242}Pu FROM 0.5 TO 5000 eV. Harvey, J. A. (Oak Ridge National Lab., TN); Hill, N. W.; Benjamin, R. W.; Ahlfeld, C. E.; Simpson, F. B.; Simpson, O. D.; Miller, H. G. Apr 1973.

Physics Division annual progress report for period ending December 31, 1972.

11898 (ORNL-4844, pp 91-93) ELECTRIC HEXADECAPOLE MOMENTS IN THE ACTINIDE NUCLEI. McGowan, F. K.; Bemis, C. E. Jr.; Ford, J. L. C. Jr.; Milner, W. T.; Stelson, P. H.; Robinson, R. L. Apr 1973.

Physics Division annual progress report for period ending December 31, 1972.

11899 (ORNL-4844, pp 94-99) STUDIES OF ^{235}U AND ^{237}Np (SUBTHRESHOLD) FISSION AT ORELA, USING POLARIZED NEUTRONS AND POLARIZED TARGETS. Keyworth, G. A. (Los Alamos Scientific Lab., NM); Dabbs, J. W. T.; Seibel, F. T.; Hill, N. W.; Anaya, J. M. Apr 1973.
Physics Division annual progress report for period ending December 31, 1972.

11900 (ORNL-4844, pp 107-109) MASS AND TOTAL KINETIC ENERGY DISTRIBUTIONS FROM THE SPONTANEOUS FISSION OF ^{246}Cm. Pleasonton, F.; Ferguson, R. L.; Plasil, F.; Bemis, C. E. Jr. Apr 1973.
Physics Division annual progress report for period ending December 31, 1972.

11901 (ORNL-4844, pp 109-112) PROMPT GAMMA RAYS EMITTED IN THE THERMAL-NEUTRON-INDUCED FISSION OF ^{233}U, ^{235}U, AND ^{239}Pu AND THE SPONTANEOUS FISSION OF ^{252}Cf. Pleasonton, F.; Ferguson, R. L.; Schmitt, H. W. Apr 1973.
Physics Division annual progress report for period ending December 31, 1972.

11902 (RLO-2227-T-7-22, pp 3-8) SHORT RANGE α-PARTICLE EMISSION IN ^{252}Cf SPONTANEOUS FISSION. Loveland, W. Mar 1973.
In nuclear chemistry progress report.

11903 (RLO-2227-T-7-22, pp 9-12) SPONTANEOUS TERNARY FISSION OF ^{252}Cf. Loveland, W.; Vieira, D. J.; Button, W. H. Mar 1973.
In nuclear chemistry progress report.

11904 (RLO-2227-T-7-22, pp 13-30) FISSION TRANSITION NUCLEUS ^{227}Ra. Groening, H.; Loveland, W. Mar 1973.
In nuclear chemistry progress report.

11905 (UCRL-51292) ACT AND ACTIVE CODES FOR CALCULATING NEUTRON-INDUCED ACTIVATION. Lessler, R. M.; Alley, W. E.; Green, J. B. (California Univ., Livermore. Lawrence Livermore Lab.). 10 Apr 1973. Contract W-7405-eng-48. 16p. Dep. NTIS $4.00.
ACT and ACTIVE are two computer programs that were written to calculate the neutron-induced radioactive products produced by a nuclear explosion. ACT calculates the products in high-flux regions, where multiple-order reactions occur, as in the explosive itself; ACTIVE calculates the products in relatively low-flux regions, where only first-order reactions are important, as in the materials around the explosive. This report explains how the codes operate and describes their input and output. (1 table) (auth)

11906 TOTAL AND ELASTIC SCATTERING NEUTRON CROSS SECTIONS OF ^{239}Pu. Smith, A.; Guenther, P.; Whalen, J. (Argonne National Lab., IL). J. Nucl. Energy; 27: No. 5, 317-325 (May 1973).
Elastic neutron scattering cross sections of ^{239}Pu are measured at $\lesssim$50 keV intervals from 0.3 to 1.5 MeV with incident neutron resolutions of $\approx$20 keV. Total neutron cross sections are measured from 0.65 to 1.5 MeV at intervals of $\lesssim$5 keV and with resolutions of $\approx$2.5 keV. The experimental results are compared with the predictions of optical and statistical models, with other measured values and with representative evaluated data. (auth)

11907 LIFETIME OF THE COMPOUND NUCLEUS ^{239}U PRODUCED IN THE ^{238}U + n REACTION AT 1.6 TO 4.3 MeV NEUTRON ENERGIES. Vorotnikov, P. E.; Melikov, Yu. V.; Otstavnov, Yu. D.; Tulinov, A. F.; Chechenin, N. G. (Moscow State Univ.). Yadern. Fiz.; 17: No. 5, 901-905(May 1973). (In Russian).
The method based on the shadow effect is applied to measure the lifetimes of the compound nucleus ^{239}U excited to the energies 6.4, 8.0 and 9.1 MeV. The obtained values are compared with the results of calculations using the level-density function in the Fermi-gas model and the level-density function obtained from the analysis of cross section data. (auth)

11908 SEARCH FOR α-EMISSION IN THE DECAY OF SPONTANEOUSLY FISSIONABLE ISOMERS. Belov, A. G.; Gangrskii, Yu. P.; Dalkhsuren, B.; Kucher, A. M.; Nguyen Kong Khanh (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 5, 942-946(May 1973). (In Russian).
The results are presented on the search of α-emission in the decay of spontaneously fissionable isomers ^{241}Pu, ^{240}Am and ^{242}Am produced in the (n,2n) reactions. The α-particles were detected by the multiwire proportional counter. No α-emitters were found with the energy higher than 7 MeV and half-lives in the region of 10^{-5} to 10^{-2} sec. Thus the α-transitions from isomeric levels appear to be in some way forbidden. (auth)

11909 SPECTRA OF THE FISSION X RAYS AT DIFFERENT KINETIC ENERGIES OF THE LIGHT FRAGMENT AND THE FINE STRUCTURE OF THE MASS YIELD. Donichkin, A. G.; Solov'ev, S. M.; Eismont, V. P. Yadern. Fiz.; 17: No. 5, 935-941(May 1973). (In Russian).
The periodicity of 5-6 mass units observed in the mass distribution of the fragments from even-even nuclei (especially at high kinetic energies i.e. small excitation energies) is usually connected with higher yield of the even-charge fragments. This assumption was experimentally analyzed by measuring the spectra of characteristic rays at different kinetic energies of light fragments produced in the spontaneous fission of ^{252}Cf. Use of the computer allowed one to find that the relative number of x-quanta, from the fragments with even proton number increases with kinetic energy. This observation presents the most probable argument for the predominant yield of even-charge fragments and therefore experimentally confirms the existing hypothesis. (auth)

11910 HEAVY IONS: LOOKING AHEAD. Hamilton, J. H.; Sellin, I. A. (Vanderbilt Univ., Nashville). Phys. Today; 26: No. 4, 42-49(Apr 1973).
The benefits of a heavy-ion accelerator capable of accelerating any element (through Z = 100) to about 10 MeV per nucleon and light ions up to 100 MeV per nucleon are reviewed. Tests of the electrodynamics of strong fields are possible; these relate to the "diving" of the 1s electron into the negative-energy sea at Z $\approx$ 137, nonlinear effects, and emission of characteristic x rays from transient "superheavy" atoms. The large amounts of angular momentum brought into the nuclear system by heavy ions enables study of very high angular momentum nuclear states. Nuclei far from stability can be produced; and their properties, perhaps quite different from those of familiar stable nuclei, studied. An accelerator with the proposed characteristics would permit clarification of nuclear models of the dynamics of Coulomb fission and direct reactions. It may also be expected to make valuable contributions in the fields of astrophysics, atomic physics, chemistry, and materials science. (4 figures) (RWR)

11911 NUCLEAR POTENTIAL-ENERGY SURFACE AND THE HALF-LIVES OF HEAVY AND SUPER-HEAVY ELEMENTS. Nilsson, S. G. (Inst. of Tech., Lund, Sweden). Comput. Phys. Commun., Suppl.; 3: 92-116(Sep 1972).
The discussion of half-lives of heavy and superheavy elements from nuclear potential-energy surfaces covers the Strutinsky and alternative procedures, results of the calculations using ϵ, ϵ_4 shapes, asymmetric degrees of freedom, rotational asymmetry, and barrier characteristics. (JFP)

11912 EIKONAL APPROXIMATION FOR MAGNETIC ELECTRON SCATTERING. Murphy, J. D.; Ueberall, H. (Catholic Univ. of America, Washington, DC). Phys. Lett.; 44B: No. 4, 347-350(14 May 1973).
The eikonal (high-energy) approximation of Yennie et al. for the scattering of electrons from nuclei has been extended to include the transverse interaction, and in particular the case of magnetic scattering. It is applied here to elastic magnetic scattering from ^{209}Bi at 500 MeV as an example. (auth)

Nuclear Theory

Refer also to abstracts 11716, 11768, 11805, 11813, 11814, 11827, 11848, and 11911.

11913 (BARC-658) PROGRAM KNMATICS: TWO BODY NUCLEAR RELATIVISTIC KINEMATICS. Srivastava, D. K.; Ganguly, N. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 30p. Dep. NTIS (U. S. Sales Only) $3.50.
Transformation relations from the laboratory frame to a center of mass frame of reference for a two-body nuclear reaction are derived ab initio. The energy of the outgoing projectile is calculated in the laboratory frame. A computer program with input-output details and test-data is given. All calculations are relativistic. (auth)

11914 (BNL-17857) TWO-NUCLEON FORM FACTORS FOR HEAVY-ION DWBA CALCULATIONS. Baltz, A. J.; Kahana, S. (Brookhaven National Lab., Upton, N. Y.). Mar 1973. 16p. (CONF-730312-8). Dep. NTIS $3.00.
From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).
The calculation of two-nucleon form factors for heavy-ion reactions in the DWBA is discussed; the approach followed is to inte-

grate directly over each nucleon coordinate. The reactions considered are of the type (A + 2N) + B → A + (B + 2N), where 2N stands for the two like nucleons transferred and A, B are inert cores. The total form factor calculated is compared with published experimental data from the (^{18}O, ^{16}O) reaction on Mo and Ni isotopes. Angular distributions are shown for ^{94}Mo and even Ni isotopes, and peak differential cross sections are tabulated for even Mo isotopes. The trends of the cross sections with isotope and energy are reasonably well reproduced. A strong dependence of the heavy-ion two-particle transfer on the nucleon bound states is found. A somewhat weaker absorption than is usually employed for heavy-ion transfer reactions seems to be appropriate for the analysis of these two-nucleon-transfer reactions. In comparing two-nucleon form factors with one-nucleon form factors, a much more rapid radial fall off in the tail region is observed for two-nucleon transfer. It is suggested that proper recoil calculations might damp the oscillations in the Ni angular distributions somewhat while preserving the grazing and forward peaked structure. (3 figures, 3 tables) (RWR)

11915 (BNL-17858) SUMMARY FOR ARGONNE SYMPOSIUM. Kahana, S. (Brookhaven National Lab., Upton, N. Y.). Apr 1973. 10p. (CONF-730312-9). Dep. NTIS $3.00.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

The symposium covered elastic scattering, inelastic scattering, and transfer reactions, all initiated by heavy projectiles ranging from ^{6}Li up to ^{32}S. The papers are summarized from the direct reaction point of view. Much attention at the symposium was devoted to the reaction mechanism. The strong selectivities exhibited by heavy-ion transfer reactions, the applicability of a semiclassical analysis, and advances in the theory are discussed with reference to specific papers presented at the symposium. (1 figure) (RWR)

11916 (COO-3494-5) NUCLEAR REACTION MECHANISMS. Progress Report, May 1972–May 1973. Blann, M. (Rochester Univ., N. Y.). 1973. Contract AT(11-1)-3494. 28p. Dep. NTIS $3.50.

Research under the subject contract was directed along two major lines: development and exploration of pre-equilibrium statistical models; experimental measurement and theoretical investigation of heavy ion reaction mechanisms, with emphasis on the limits on compound nucleus formation. Much of the work under this contract has been published, and a list of publications is part of this report. This work is not otherwise summarized herein. Abstracts of papers submitted for publication are reproduced in this report, and new unpublished results on heavy ion reactions are briefly summarized. Colloquia and addresses since the last reporting period are also summarized. (auth)

For an abstract of an individual paper see: 11833.

11917 (JEN-259) PROBABILITIES OF NUCLEAR PROCESSES. Sanchez del Rio, C. (Junta de Energia Nuclear, Madrid (Spain). Division de Fisica). 1973. 18p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

This report is the first draft of one of the chapters of a book being prepared under the title "Topics on Practical Nuclear Physics." Under the general topic of cross sections, the following processes are considered: attenuation of a beam in a foil, radioactive decay with formation of radioactive nuclei and radioactive chains, and statistical fluctuations. (1 figure) (J.S.R.)

11918 (N-72-30618) NONELASTIC NUCLEAR REACTIONS AND ACCOMPANYING GAMMA RADIATION. Final report. Snow, R.; Rosner, H. R.; George, M. C.; Hayes, J. D. (Teledyne Brown Engineering, Huntsville, Ala. (USA)). Sep 1971. Contract NAS8-25534. 237p. (NASA-CR-121023; SE-SSL-1407). NTIS.

Several aspects of nonelastic nuclear reactions which proceed through the formation of a compound nucleus are considered. The full statistical model and the partial statistical model are described, and computer programs based on these models are presented along with operating instructions and input and output for sample problems. A theoretical development of the expression for the reaction cross section for the hybrid case which involves a combination of the continuum aspects of the full statistical model with the discrete level aspects of the partial statistical model is presented. Cross sections for level excitation and gamma production by neutron inelastic scattering from the nuclei ^{27}Al, ^{56}Fe, ^{28}Si, and ^{208}Pb are calculated and compared with available experimental data. (auth)

11919 (N-73-16665) COMPARISON OF THE RESULTS OF CALCULATIONS DONE AT DIFFERENT LABORATORIES WITH EACH OTHER AND WITH EXPERIMENTS ON THE SECONDARY PROTON AND NEUTRON SPECTRA FROM PROTONS AT 140 AND 160 MeV ON NUCLEI. Bertini, H. W. (Oak Ridge National Lab., Tenn.). 28 Jul 1966. 32p. (NASA-CR-130347). NTIS.

Comparisons are illustrated between calculations on those parts of the secondary proton and neutron spectra that lie above about 20 MeV and that are measured at various angles. The interactions are 140- and 160-MeV protons on several elements ranging from aluminum to bismuth. The calculation that differs most from experimental results is probably the Brookhaven calculation, which is the latest and most detailed. The differences are apparently due to inclusion of reflection and refraction effects in the calculation. When these effects are not included, the results from all calculations are very similar. (auth) (STAR)

11920 (ORNL-4844, pp 17-18) BRUECKNERIZATION OF THE BRANDOW SERIES WITH A NEW PROPAGATOR-RENORMALIZED REACTION MATRIX. Becker, R. L. Apr 1973.

Physics Division annual progress report for period ending December 31, 1972.

11921 (ORNL-4844, pp 22-23) COULOMB ENERGY DIFFERENCES IN s–d-SHELL NUCLEI IN THE CONVENTIONAL SHELL MODEL. McGrory, J. B. Apr 1973.

Physics Division annual progress report for period ending December 31, 1972.

11922 (ORNL-4844, pp 103-105) DEPENDENCE OF FISSION MASS ASYMMETRY ON THE INTERNAL EXCITATION ENERGY OF THE FISSIONING NUCLEUS. Mustafa, M. G. (Atomic Energy Centre, Dacca, Pakistan); Schmitt, H. W. Apr 1973.

Physics Division annual progress report for period ending December 31, 1972.

11923 (RLO-2227-T-7-18) FUNDAMENTALS OF NUCLEAR SCIENCE. I. NUCLEAR STRUCTURE AND NUCLEAR REACTIONS. Loveland, W. D. (Oregon State Univ., Corvallis. Dept. of Chemistry). 1972. 31p. (CONF-720855-1). Dep. NTIS $3.75.

From electric power generation workshop; Corvallis, Oregon, USA (Aug 1972).

A review is given on some of the fundamentals of nuclear structure and nuclear reactions as a background for discussions on the use of nuclear energy for electric power generation. (LBS)

11924 (UJF-2905-F) CORRELATION EFFECTS IN THE THEORY OF ELECTRON SCATTERING BY NUCLEI. Kabachnik, N. M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). Mar 1973. 29p. Dep. NTIS (U.S. Sales Only) $3.50.

A number of examples of the influence of the different nucleon correlations on high energy electron scattering is considered. Elastic electron scattering and the role of short-range correlations are discussed. Excitation of giant electric and magnetic resonances in inelastic electron scattering was investigated. The influence of the continuous spectrum on the formation of giant resonance and its excitation by electron are discussed. Finally, collective aspects of the theory of quasi-elastic electron scattering are considered. It is shown that in all cases the correlation effects proved to be considerable; they substantially change and even determine the behavior of the scattering cross section. (auth)

11925 SOME TOPICS IN THE THEORY AND APPLICATIONS OF THE OPTICAL MODEL. Bertero, M.; Passatore, G. (Univ., Geneva). Z. Naturforsch.; 28a: No. 3–4, 519-529(1973).

In some recent reports a dispersion relation proposed by Feshbach for the generalized optical potential has been used in order to analyze the energy dependence of the strength of the empirical optical potential. In the first part of this report the mathematical problems arising in the derivation of the dispersion relation and the results obtained in this direction are discussed; in the second part the approximations introduced in the application of the dispersion relation are analyzed, and the results concerning the nonlocality of the generalized optical potential are reviewed. (2 figures) (auth)

11926 NUCLEAR REACTIONS AND MECHANISMS OF REACTION. III. Nalda, J. C. (Facultad de Ciencias, Valladolid, Spain). Energ. Nucl. (Madrid); 17: No. 81, 35-50(1973). (In Spanish).

There are discussions of reactions with more than two bodies in the final state, including sequential reactions; knockout reactions and the Faddeev method; and structural phenomena related to the mechanisms of reaction, including shell effects, the effects of isospin conservation, and cluster phenomena in nuclei. There is also included an extended list of bibliographic references that refer to this part of the article and also to the two previous parts. (6 figures) (tr-auth)

11927 TRANSFER REACTIONS WITH HEAVY IONS. Strutinskii, V. M. (Inst. for Nuclear Research, Kiev). Phys. Lett.; 44B: No. 3, 245-248(30 Apr 1973).

A simple model is derived for angular distributions in heavy ion transfer reactions which takes into account the dynamic as well as the quantal dispersion of the wave packet. (auth)

11928 K-HARMONIC METHOD IN THE THREE-BODY NUCLEAR PROBLEM. Efros, V. D. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 17: No. 5, 988-1000(May 1973). (In Russian).

The method of constructing (by means of matrix diagonalization) the complete orthogonal system of hyperspherical functions forming the bases of the irreducible representations of the three-particle permutation group is given. The required functions are constructed as the expansion in known hyperspherical functions. A simple explicit formula for the coefficients of the expansion is given for small L. The coefficients of the expansion are simply expressed in terms of the Talmi coefficients. Matrix elements of a certain type in the basis are expressed through those in the harmonic oscillator basis. The Euler angles are separated in the three-particle functions. (auth)

11929 EFFECT OF EXCHANGE FORCES ON SUM RULE FOR THE ELECTRON-NUCLEUS SCATTERING. Inopin, E. V.; Roshchupkin, S. N. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 17: No. 5, 1008-1011(May 1973). (In Russian).

The effect of the exchange part of nucleon-nucleon interaction on the sum rule for the electron-nuclei scattering $\int_0^\infty \omega R(q,\omega)d\omega = Zq^2/2m$ is considered where q, ω are the momentum and energy transferred to the nucleus, Z is the number of protons, m is the nucleon mass, $R(q,\omega)$ is the dynamical form factor of the nucleus. It is shown that the correction weakly depends on the properties of nucleus and is determined only by the properties of NN-interaction. The value of correction for Rosenfeld and Volkoff forces achieves several dozens of per cent for $q \sim 1f^{-1}$ and rapidly decreases with q. (auth)

11930 EFFECT OF THE SURFACE CURVATURE AND NUCLEAR COULOMB FIELD ON THE NUCLEON DISTRIBUTION. Tyapin, A. S. Yadern. Fiz.; 17: No. 5, 968-974(May 1973). (In Russian).

The model statistical calculation of the distribution of nucleons inside nuclei is made taking into account the corrections for the surface curvature and Coulomb repulsion of protons. The form factor of the distribution is calculated at large momentum transfer. It coincides with the form factor of Fermi distribution with appropriate radius and diffuseness parameter. The data on the elastic scattering of fast electrons by the ^{40}Ca nucleus were used to obtain the following estimations of the equilibrium density of nucleons and of the skin thickness in a half-infinite nuclear matter: $\rho^* = 0.157\ F^{-3}$, $t = 2.27$ F. The maximum density and width of the charge-diffused region observed in the electron scattering experiments differ from the above-mentioned estimations due to the nuclear surface curvature, Coulomb repulsion of protons, isotopic effects and also due to the finite radius of a proton. (auth)

11931 APPLICABILITY OF THE QUASI-PARTICLE EXCITATION MODEL IN THE VICINITY OF THE SADDLE POINT OF THE FISSIONABLE NUCLEUS. Savel'ev, A. E.; Khoruzhii, V. Kh.; Zhikhareva, S. V. Yadern. Fiz.; 17: No. 5, 957-967(May 1973). (In Russian).

The dependence of the number of prompt neutrons emitted in fission upon the excitation energy of fragments in calculated in the framework of the cascade theory of neutron emission. The obtained dependence is used to calculate the total number of neutrons per a fission event $\bar{\nu}$ as a function of the energy of the fissioning neutron E_n. Comparison of the theoretical dependence $\bar{\nu}(E_n)$ with the experimental data allows one to draw conclusions on the applicability of the model of quasi-particle above-threshold excitations to the description of fission. (auth)

11932 RELATIVISTIC, THREE-DIMENSIONAL EQUATIONS FOR LOW ENERGY TWO-NUCLEON SYSTEMS. Erkelenz, K.; Holinde, K. (Univ., Bonn). Z. Naturforsch., 28a: No. 3-4, 353-361(1973).

The manifestly covariant Bethe-Salpeter equation is reduced to relativistic, three-dimensional integral equations suitable for the dynamical treatment of the two-nucleon system at low energies. The reduction is achieved by restricting one of the nucleons to the mass shell. The resulting two-nucleon scattering equations and bound state equations are Schroedinger-like field equations containing relativistic kinematical corrections. The transformation of these equations to the ordinary Schroedinger (or Lippmann-Schwinger)-equation is discussed. Intimately connected with the reduction is the derivation of a meson field mediated two-nucleon potential containing meson retardation effects and adequate for the application to the two-nucleon system and nuclear structure problems. (auth)

11933 EFFECTIVE KINETIC ENERGY. I. KINETIC ENERGY, THE INTERNUCLEON INTERACTION, AND THE BINDING AND EXCITATION ENERGIES OF LIGHT NUCLEI. Nash, G. F. (Univ. of Southampton, Eng.). Fizika (Zagreb); 5: No. 1, 1-15 (Mar 1973).

In order to find a simple shell-model Hamiltonian which at the same time gave the experimental binding energy of the ground state of light nuclei and their correct excitation energies, various assumptions were made concerning the effective kinetic energy of a nucleon in the nucleus. The potentials possessed large repulsive matrix elements in p states, which together with the reduction in kinetic energy resulted in the lowering of the deformed excited states to the experimental region. The binding energies of the spherical nuclei were also given correctly. (auth)

11934 APPLICATION OF THE PADE APPROXIMATION IN NUCLEAR PHYSICS. Alder, K.; Trautmann, D.; Viollier, R. D. (Univ., Basel). Z. Naturforsch.; 28a: No. 3-4, 321-331(1973). (In German).

It is shown that poorly converging series of Legendre polynomials or spherical harmonics can be well approximated by the method of the Pade approximation. The improvement of the convergence will be discussed with the help of three model series which can be calculated exactly. (auth)

11935 SCHROEDINGER EQUATION FOR COLLECTIVE MOTION FROM THE GENERATOR COORDINATE METHOD. Banerjee, B. (Technische Univ. Munich, Garching, Ger.); Brink, D. M. Z. Phys.; 258: No. 1, 46-55(1973).

It is shown that if the collective wave function occurring in the Griffin–Hill–Wheeler integral equation is slowly varying, the equation can be transformed into a Schroedinger equation. The conditions under which this can be done are studied in detail. (GE)

11936 GROUP THEORETICAL INVESTIGATION OF THE BOGOLYUBOV–VALATIN TRANSFORMATION AND THE HFB STATE. Becker, H. G. (Univ., Bonn.). Z. Naturforsch.; 28a: No. 3-4, 332-342(1973). (In German).

The structure of the Bogolyubov–Valatin transformation and the HFB state is investigated by group-theoretical methods. A direct proof of the Bloch–Messiah factorization theorem shows that the second factor which contains the BCS part of the BV transformation can be chosen always real. A Valatin representation of the Bogolyubov–Valatin group in the Fock space is constructed which allows one to write down various equivalent expressions for the HFB state vector. The relation between the "unitary form" and the usual form of the HFB state vector is clarified using the "quasispin" concept in connection with a theorem about the factorization of the O(3) Lie group. (auth)

11937 GENERATOR COORDINATE METHOD AND SHORT RANGE CORRELATIONS. da Providencia, J. (Univ. of Combra). Z. Naturforsch.; 28a: No. 3-4, 393-395(1973).

It is shown that the cluster expansion formalism previously developed as a basis for a theory of the ground state of correlated systems may be generalized in such a way as to enable the application of the generator coordinate method in the presence of interactions, thereby providing also a theory for excited states. (auth)

11938 GENERATOR COORDINATES AND RANDOM-PHASE APPROXIMATION. Hadermann, J. (Univ., Bonn.). Z. Naturforsch.; 28a: No. 3-4, 383-386(1973). (In German).

The method of generator coordinates is applied to a two level model with pairing and monopole force. The harmonic approximation is investigated. By proper inclusion of the symmetries of the Hamiltonian an improvement over the usual random-phase approximation results. (auth)

11939 PARITY-VIOLATING NUCLEON ONE-MESON EXCHANGE POTENTIALS IN A CURRENT-CURRENT QUARK MODEL. Koerner, J. G. (Univ., Heidelberg). Phys. Lett.; 44B: No. 4, 361-365(14 May 1973).

The parity-violating coupling constants $A_{NN\pi}$ and $h^A_{NN\rho(\omega)}$ are calculated in the framework of a current-current quark model and from these the nucleon one-meson-exchange potentials are determined. Compared to the previously used potentials a much weaker π-exchange and a somewhat stronger $\rho(\omega)$-exchange potential are obtained. In contrast to the isospin-violating ρ-exchange potential resulting from the standard factorization approach (i.e., $\Delta I = 0, 2$) our $\rho(\omega)$-exchange is isospin-conserving. (auth)

11940 BACK-BENDING IN ROTATIONAL SPECTRA AND PARTICLE NUMBER PROJECTION. Dalafi, H. R.; Banerjee, B.; Mang, H. J.; Ring, P. (Technische Univ., Munich). Phys. Lett.; 44B: No. 4, 327-329(14 May 1973).

Hartree–Fock–Bogoliubov theory with approximate projection of particle number is used to calculate the nuclear moment of

inertia within the framework of the cranking model. The plot of the moment of inertia Θ versus the square of the angular velocity ω^2, gives an S-shaped curve the socalled "back-bending" effect. (auth)

11941 MINIMIZATION OF ENERGY VARIANCE FOR A DETERMINANTAL STATE AS A USEFUL VARIATION OF THE HARTREE–FOCK THEME. Bhatt, K.; Parikh, J. (Physical Research Lab., Ahmedabad, IN). Phys. Lett.; 44B: No. 4, 338-340(14 May 1973).

It is suggested that a single determinantal state in the neighborhood of the Hartree–Fock state, having the minimum energy variance might be a "better" intrinsic state for describing some of the low energy states of a nucleus. At higher excitation energies the resulting orbitals may provide a suitable single-particle basis for describing the nuclear level density at that energy. (auth)

11942 E2 AND E0 TRANSITIONS FROM EXCITED 0^+ BANDS TO THE GROUND STATE BAND IN EVEN–EVEN DEFORMED NUCLEI. Silverstre-Brac, B.; Piepenbring, R. (Institut des Sciences Nucleaires, Grenoble, FR). Phys. Lett.; 44B: No. 4, 357-360(14 May 1973).

In the frame of the R.P.A., a generalization of the dispersion equation is given for the study of E2 and E0 properties of excited 0^+ states even-even deformed nuclei. (auth)

11943 SEMI-CLASSICAL MODEL FOR ASYMMETRIC FISSION. Grammaticos, B. (CEN de Saclay-Gif-sur-Yvette, FR). Phys. Lett.; 44B: No. 4, 343-346(14 May 1973).

An asymptotic expansion for the smooth and fluctuating parts of the level density for deformed nuclei is used for the calculation of fission maps. (auth)

11944 F-MATRIX CALCULATION OF PENETRABILITY THROUGH DOUBLE HUMP FISSION BARRIERS. Leboeuf, J.N.; Sharma, R. C. (Sir George Williams Univ., Montreal). Nucl. Phys.; A208: No. 3, 514-524(1973).

Penetrability through double-hump fission barriers is derived in the JWKB approximation using a generalized method based on Fröman's F-matrix formalism. This general expression is applied to different physical situations vital to fission phenomena. A detailed discussion of the results obtained is also given. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

11945 PLASMA PHYSICS INDEX. Volume 8, No. 5, 1973. Bibliography, Author Index, Subject Index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 187p.
This listing contains 551 references. (MOW)

Confinement and Heating

11946 (CONF-730705-1) PHYSICS OF TARGET PLASMAS IN MINIMUM-B GEOMETRIES. Ard, W. B.; Colchin, R. J.; Crume, E. C., Dunlap, J. L.; Haste, G. R.; Lazar, N. H.; Lyon, J. F. (Oak Ridge National Lab., Tenn.). 1973. 7p. Dep. NTIS $3.00.
The experiments were performed in the IMP facility, where superconducting mirror and quadrupole windings provide a variety of field configurations. The microwave sources have frequencies of 36 and 55 GHz. The power at 36 GHz is used for resonant heating and that at 55 GHz for upper off-resonant heating. Density profiles are shown for typical experiments. (MOW)

11947 (CONF-730705-5) PLASMA CONFINEMENT PROPERTIES IN FM1-SPHERATOR. Chen, K.; Meade, D.; Okabayashi, M.; Schmidt, J.; Yoshikawa, S. (Princeton Univ., N. J. Plasma Physics Lab.). 1972. 4p. Dep. NTIS $3.00.
Plasma confinement time in FM-1 was investigated at high electron temperature (T_e = 10 to 100 eV). The confinement time is consistent with the assumption of $\tau = 150$ to 300 τ_B. (auth)

11948 (LA-5132-MS) NONLINEAR DIFFUSION OF PULSED MAGNETIC FIELDS IN PLANAR AND CYLINDRICAL PLASMAS. Haberstich, A. (Los Alamos Scientific Lab., N. Mex.). Jun 1973. Contract W-7405-eng-36. 13p. Dep. NTIS $3.00.
The one-dimensional, one-component, nonlinear diffusion of pulsed magnetic fields in planar and cylindrical geometries is examined. The diffusion coefficient μ depends abruptly on the current density j associated with the gradient of the magnetic field. The coefficient μ is large when $j \geq j_1$, small when $j \leq j_2$, and depends linearly on j in the interval $j_2 < j < j_1$, where j_1 and j_2 are given current densities. A traveling-wave solution is obtained in planar geometry and it is found that the product μj remains continuous in space in the limit $(j_1 - j_2) \rightarrow 0$. Analytic and finite-difference solutions of the traveling-wave problem are compared, numerical stability conditions are found, and an estimate of the numerical error is obtained. The pulsed magnetic field problem is then solved numerically in the two geometries. Large portions of the magnetic field profiles exhibit a nearly uniform current density distribution at some time during the diffusion. (auth)

11949 (UCRL-74628) COMPARISON OF LASER-HEATED FUSION PLASMA PROPOSALS. Shearer, J. W. (California Univ., Livermore. Lawrence Livermore Lab.). 10 Mar 1973. 6p. (CONF-730705-9). Dep. NTIS $3.00.
In recent years, high-power lasers have become an important potential tool for manipulating fusion plasmas. Several fusion plasma proposals involving laser radiation are briefly reviewed. (auth)

11950 (UCRL-74716) 200-kW NEUTRAL-BEAM INJECTION INTO THE 2XII MIRROR DEVICE. Coensgen, F. H.; Cummins, W. F.; Nexsen, W. E. Jr.; Molvik, A. W.; Simonen, T. C. (California Univ., Livermore. Lawrence Livermore Lab.). 23 Apr 1973. 6p. (CONF-730705-6). Dep. NTIS $3.00.
Results on injection of a 10-A, 20-keV neutral beam into the 2XII minimum-B mirror device are reported. Beam attenuation exceeding 50% is measured, with approximately 10 joules deposited into the 2XII plasma. Particle deceleration at least as fast as Coulomb dynamical friction is observed. The beam does not drive instabilities. (auth)

11951 INJECTION OF A STREAMING PLASMA INTO A MIRROR MACHINE. Johnson, B. W.; Siambis, J. G. (Carnegie Inst. of Tech., Pittsburgh). Plasma Phys.; 15: No. 5, 369-374(May 1973).
The axial injection of a supersonically streaming plasma beam into a mirror machine is investigated experimentally. It is shown that for a mirror ratio of 3:3 and for a peak mirror field in excess of 3 kG, a shock is formed in the downstream mirror and results in increased density and temperature confinement time within the mirror machine. The helium plasma beam is produced by a conical theta-pinch gun driven by a capacitor bank with a stored energy of 2.5 kJ. Measurements are made of the plasma density, temperature, and streaming velocity. (auth)

Diagnostics

11952 (EUR-CEA-FC-680) ELECTROSTATIC ANALYZER FOR MEASURING THE PLASMA POTENTIAL IN THE CIRCE EXPERIMENT. Dupas, L.; Melin, G. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan 1973. 17p. (In French). Dep. NTIS (U.S. Sales Only) $3.00.
Measurements of the velocity distribution of particles lost at the mirror in the CIRCE experiment can be used to obtain a value for the plasma potential in the magnetic bottle: cold electrons produced in collisions between energetic electrons and neutral particles leave the magnetic bottle with an energy equal to that of the electrostatic well in which they were created. (FR)

11953 CONTINUOUS MEASUREMENT TECHNIQUE OF THE ENERGY OF CHARGED PARTICLES IN A PLASMA BY MEANS OF A MULTIGRID ELECTROSTATIC ANALYZER. Golovanivskii, K. S.; Guseinova, A. D.; Dugar-Zhabon, V. D.; Lushchik, A. I. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 12, 1797-1800(Dec 1972).
Translated from Izmer. Tekh.; 15: No. 12, 34-36(Dec 1972).
The investigation of the energy distribution of charged particles in a plasma and also in unipolar beams of charged particles is of fundamental interest for many physical and applied problems. A procedure is described here for using an electrostatic analyzer to record directly on an oscilloscope the energy distribution functions of charged particles; the results of measurements also are given, carried out by the procedure described under various physical conditions. In particular, the results are presented of measurements of the beam parameters from the plasma from a uhf discharge and a plasma stream obtained from a source with oscillating electrodes. (auth)

11954 INFRARED PLASMA DIAGNOSTIC METHODS. Soloukhin, R. I.; Yakobi, Yu. A. (Inst. of Theoretical and Applied Mechanics, Novosibirsk, USSR). High Temp. (USSR) (Engl. Transl.); 10: No. 6, 1176-1181(1972).
Translated from Teplofiz. Vys. Temp.; 10: No. 6, 1307-1314 (1972).
A brief review of new methods for measuring plasma parameters with CO_2 lasers is presented. (auth)

11955 DETERMINATION OF ELECTRON TEMPERATURE OF A PLASMA BY PROBING THE EXTRAORDINARY WAVE ALONG A MAGNETIC FIELD. Bredikhin, M. Yu.; Maslov, A. I.; Skibenko, A. I.; Skibenko, E. I.; Fomin, I. P.; Yuferov, V. B. (Physical-Technical Inst., Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 6, 1068-1073(1972).
Translated from Teplofiz. Vys. Temp.; 10: No. 6, 1188-1194 (1972).
The possibility of determining the temperature of a plasma by probing the extraordinary wave, with the probing field frequency less than the electron cyclotron frequency and with electron concentration above critical is considered. The absorption coefficient of this kind of plasma, which is transparent only for the extraordinary wave, depends appreciably on the magnetic field intensity. This makes it possible to determine the effective collision frequency from the relative change in the wave amplitude for a small variation in the magnetic field. The region of variation is chosen so that collisional absorption dominates over other kinds. Experimental investigations have been performed for λ = 3 cm and H = 4 to 10 kG. The observed values of temperature are compared with results of diamagnetic measurements. (auth)

Kinetics (General)

11956 MACROSCOPIC EQUILIBRIA OF RELATIVISTIC ELECTRON BEAMS IN PLASMAS. Kueppers, G.; Salat, A.; Wimmel, H. K. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 15: No. 5, 441-454(May 1973).
Macroscopic equilibria of relativistic electron beams in plasmas, with return current and with or without an external magnetic field parallel to the beam, are investigated in cylindrical geometry. Bennett-type identities and general solutions are derived, and special examples are considered, in particular low-net-current, quasi-neutral configurations. A general expression for the current screening factor is obtained. (auth)

11957 CURRENT AND FIELDS INDUCED IN PLASMAS BY RELATIVISTIC ELECTRON BEAMS WITH ARBITRARY RADIAL

AND AXIAL DENSITY PROFILES. Kueppers, G.; Salat, A.; Wimmel, H. K. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 15: No. 5, 429–439(May 1973).

The return current and the electric and magnetic fields resulting from injection of a relativistic electron beam of arbitrary radial and axial density profile into a plasma are investigated. It is found that, in general, the radial step function profile used in previous calculations is overestimated. The results apply to the first (inertial) stages of beam injection, where collisions can be ignored. (auth)

11958 EVOLUTION OF TURBULENT MAGNETIC FIELDS IN A COLLISION-DOMINATED PLASMA. Lerche, I. (Univ. of Chicago). Plasma Phys.; 15: No. 5, 417–428(May 1973).

In a weakly ionized plasma, in which collisions with the neutral background control the velocity fields of the ions and electrons against pressure gradients and the Lorentz force, it is demonstrated that: (1) the energy density in the turbulent magnetic field declines as time progresses, (2) the rate of decline depends on the amount of "helicity" present in the turbulent magnetic field, (3) the "helicity" must either be zero or must take on one of its two possible equipartition values, which are equal and opposite, and (4) the effect of helicity is to increase the rate of decay of the long-wavelength modes of the turbulent field over the decay rate obtaining in its absence. (auth)

11959 COLLECTIVE INTERACTIONS AND ELECTRICAL CONDUCTIVITY OF PLASMA IN STRONG ELECTRIC FIELDS. Suprunenko, V. A.; Sukhomlin, E. A.; Tolok, V. T. (Physical-Technical Inst., Kharkov). Plasma Phys.; 15: No. 5, 353-367 (May 1973).

Experiments are analysed which investigate the anomalous electrical conductivity of plasma over a wide range of electric field strengths. The plasma conductivity at medium electric fields is shown to depend in a complex way on the electric field, the exact nature depending upon the type of magnetic trap. Streaming instabilities, primarily the ion sound instabilities, are the main physical mechanisms governing the anomalous resistance. The dynamics of streaming instabilities in the discharge are studied, and their relative importance in the process of development of a gas discharge is clarified. (auth)

11960 RECOMBINATION OF DOUBLY IONIZED ATOMS IN THE AFTERGLOW OF A HELIUM PLASMA PRODUCED BY LASER. Baravian, G.; Benattar, R.; Bretagne, J.; Godart, J. L.; Sultan, G. (Paris Univ., Orsay, France). Z. Phys.; 260: No. 2, 121-130(1973).

Experimental investigation of the collisional–radiative decay coefficient of doubly ionized helium atoms in a helium plasma produced by lasers is reported. Comparison of the experimental values with the theoretical values determined by Drawin–Emard is made. A reasonable agreement is obtained if one takes into account the optical thickness of the plasma. (GE)

11961 PLASMA ENGINEERING. Kettani, M. A.; Hoyaux, M. F. Halsted Press Book. New York; John Wiley and Sons, Inc. (1973). 452p. $38.50.

The following chapters are included: (1) fundamental plasma processes, (2) plasma equations, (3) radiations and waves in plasmas, (4) plasma instabilities and turbulence, (5) plasma diagnostic methods, (6) thermonuclear fusion, (7) MHD applications, (8) thermionic applications, (9) masers and lasers, (10) solid-state plasmas, and (11) astrophysics and space sciences. (MOW)

11962 FUSION POWER: PAST, PRESENT, AND FUTURE. Hirsch, R. L. (Atomic Energy Commission, Washington, DC). Combustion; 44: No. 12, 37–42(Jun 1973).

The past and present of fusion research is reviewed from a somewhat abstract point of view in an effort to show why current projections for the future of fusion research are so much more meaningful today than they have been in years past. Finally, the current view of the years ahead in fusion is described. (MOW)

11963 LOWERING OF EXCITED-STATE POPULATIONS OF He I IN A He PLASMA UNDER THE INFLUENCE OF LASER RADIATION. Chapelle, J. (Centre de Recherches sur la Physique des Hautes Temperatures, Orleans, France); Dubreuil, B.; Drawin, H. W.; Emard, F. Phys. Lett., 44A: No. 3, 201-202(4 Jun 1973).

The number of excited helium atoms in a helium plasma decreases when it is irradiated by a CO_2 laser beam ($\lambda = 10.59\ \mu$, power density $\approx 10^5$ W/cm^2). The lowering increases with principal quantum number in agreement with a theoretical model involving photoionization and gas heating. (auth)

11964 CONTRACTION OF CURRENT-CARRYING PLASMA. Pashkin, S. V. (Inst. of Atomic Energy, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 6, 1058-1061(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 6, 1176-1180 (1972).

Special aspects of the contraction of an arc discharge in various gas mixtures are considered. The conditions for the existence of a "normal current density" in the discharge are found. An explanation is given for experimentally observed sharp changes in current density with changing concentration of alkali additives and molecular impurities. Various methods of obtaining diffuse discharges in gas mixtures are discussed. (auth)

11965 MODEL OF IONIZATION AND RECOMBINATION CHANNELS IN THE KINETICS OF IONIZATION RELAXATION. Fisun, O. I. (Kiev State Univ.). High Temp. (USSR) (Engl. Transl.); 10: No. 6, 1062-1067(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 6, 1181-1187 (1972).

An attempt is made to explain the difference between the ways in which two energetically close levels are populated during ionization relaxation. Ionization and recombination are interpreted in terms of an electron diffusing in a discrete energy spectrum and it is assumed that there exist channels through which the excited states are populated. Expressions are obtained for the effective probabilities of single-quantum transitions for each channel and also for the fluxes in each channel as functions of $n_e(t)$ and $T_e(t)$. The population of the levels in each of the channels is also found under the assumption that the flux is quasi-stationary over a section of the energy space. (auth)

11966 CULHAM LABORATORY. Work in Progress. Pease, R. S. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Chem. Ind. (London); No. 10, 445–449(19 May 1973).

A description is given of research on controlled nuclear fusion at the Culham Laboratory of the UKAEA. Other work includes research on the fusion reactor programme, on lightning simulation, on electric thrustors for satellites, on laser applications, and on astrophysics. The future programme is also outlined. (UK).

Kinetics (Experimental)

11967 DECAY OF A HIGH TEMPERATURE HELIUM PLASMA. Validity of Local Thermodynamic Equilibrium and Estimation of Recombination Coefficients for He^{++}, He^+, and He_2^+. Roberts, D. E. (Univ. of British Columbia, Vancouver). J. Phys., B (London); 6: No. 5, 929-944(May 1973).

The current through a high-temperature, high-density helium arc plasma was removed in approximately 1 μs, and the subsequent plasma decay observed. Various spectroscopic methods of measuring electron temperature were investigated. It was found that, depending on the method, errors of as much as a factor of six could be made if local thermodynamic equilibrium were assumed to hold throughout the decay phase. The results were then used to deduce collisional–radiative recombination coefficients of He and He^+ as functions of electron temperature. Dissociative recombination coefficients for He_2^+ were also obtained. The collisional–radiative results for He are in good agreement with calculations, the effective three-body recombination coefficient having an $\propto T^{-5\cdot9}$ temperature dependence. For He^+ the temperature dependence of the recombination coefficient is weaker ($\propto T^{-3\cdot9}$) than theory suggests ($\propto T^{-4\cdot8}$). The dissociative recombination coefficients are consistent with recent measurements at much lower electron temperatures and a $T^{-1\cdot5}$ temperature dependence. (auth)

11968 ELECTRON DENSITY DISTRIBUTION IN MAGNETIZED HYDROGEN ARC PLASMAS WITH THE ION TEMPERATURE DEVIATING FROM THE ELECTRON TEMPERATURE. Venus, G. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Z. Phys.; 259: No. 5, 437–450(1973). (In German).

The radial distribution of the electron density n_e ($n_e \simeq 10^{16}$ cm^{-3}) in hydrogen arc plasmas in a strong axial magnetic field is determined by measuring the rotation of the polarization plane of linearly polarized light (Faraday effect). As expected, it is found that the electron density decreases towards the discharge axis, i.e., with increasing temperature, but again rises near the axis. This increase is due to a thermomagnetic effect, the Nernst effect, in cases where the ion temperature is much lower than the electron temperature. (GE)

11969 RADIATIVE PROPERTIES OF A DENSE PLASMA FOCUS. Kozlov, N. P.; Protasov, Yu. S. (Bauman Higher Technical School, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 6, 1187-1188(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 6, 1319-1320 (1972).

The radiative properties of a dense plasma focus in accelerators

with coaxial and end-type geometry for the electron accelerators were investigated. Teflon and the products of the erosion of the copper electrodes were used as a working material. The spectrum of the plasma was investigated in the region 2000 to 6000 Å. (MOW)

Kinetics (Theoretical)

11970 (AD-745106) GAS-EMBEDDED Z PINCH AND NUMERICAL SIMULATION OF HIGH-DENSITY PLASMA DEVICES. Final Report. Tidman, D. A. (VERSAR, Inc., Springfield, Va. (USA)). Jun 1972. Contract N00014-71-C-0082. 45p. NTIS.

The first six sections of the report summarize work on the gas-embedded z pinch. The next section contains a description of work in progress to develop a numerical simulation of the lithium "liner" for the collapsing theta-pinch experiment (and other devices). (auth)

11971 (COO-2059-20) ELECTRIC FIELD CORRELATIONS IN THE GUIDING-CENTER PLASMA. Joyce, G.; Montgomery, D.; Emery, M. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Apr 1973. Contract AT(11-1)-2059. 21p. Dep. NTIS $3.25.

Electric field autocorrelations for the two-dimensional electrostatic guiding-center plasma are calculated numerically. It is concluded that the autocorrelation, averaged over a thermal equilibrium ensemble, is damped in an approximately exponential fashion, as predicted by Taylor and McNamara (Phys. Fluids; 14: 1492(1971)). Oscillatory behavior of the type predicted by Taylor and Thompson (Phys. Fluids; 16: 111(1973)) is not observed. (auth)

11972 (COO-2059-22) PLASMA SIMULATION AS EIGENVALUE PROBLEM. Knorr, G.; Shoucri, M. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). May 1973. Contract AT(11-1)-2059. 18p. Dep. NTIS $3.00.

A numerical integration of the Vlasov equation replaces the continuous eigenvalue spectrum of the problem by a discrete spectrum, which can be represented by the eigenvalue spectrum of a finite matrix. This matrix must be dissipative, i.e., the eigenvalues must have a negative real part in order to avoid recurrence effects. Several dissipative terms in the diagonal of the matrix are studied numerically and analytically, and the influence of various parameters is investigated. It is shown that a decrease of the last few off-diagonal terms in the matrix may also enhance the damping. (auth)

11973 (FRNC-TH-284) STUDY OF NONLINEAR EFFECTS IN PARTIALLY IONIZED PLASMAS. Chakroun, H. (Paris Univ. (France)). 1971. 73p. (In French). NTIS (U.S. Sales Only).

Thesis.

Nonlinear effect occurring in a homogeneous partially ionized non-Lorentzian plasma subjected to one or several external electric fields were studied. A method involving the expansion of the electron distribution function in terms of a small parameter dependent on the field and the characteristic parameters of the plasma considered was used. The following three cases were considered: a constant field, an alternating field, and two superimposed alternating fields. It was possible to evaluate the effects that lead to the production of harmonics in the plasma current. The electron currents were calculated from the isotope part of the electron distribution function. In establishing this function, a linear integral differential equation that can only be resolved for particular cases was encountered. This equation was solved for certain particular cases characterized by the degree of ionization of the plasma. The method was extended to the inhomogeneous case. The results of Shkonofsky were reestablished for the case of the superposition of two waves (occurrence of a pulsating harmonic). (FR)

11974 (LA-5269-MS) ENERGY LOSS OF A RELATIVISTIC ELECTRON BEAM IN A PLASMA. Gerwin, R. A. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 15p. Dep. NTIS $4.00.

The energy loss of a finite-radius, finite-length, low-density, relativistic electron beam propagating through a resistive, infinite, field-free plasma is calculated. The presentation is both more general and more quantitative than the estimate of Lovelace and Sudan [Phys. Rev. Lett., 27: 1256 (1971)] who neglected the excitation of plasma oscillations, assumed a beam of infinite extent behind the beam head, and did not utilize the exact solution of the relevant electromagnetic diffusion equation. Here, a unified calculation of the energy loss to both longitudinal and transverse plasma disturbances is presented, wherein are incorporated the exact solutions of Maxwell's equations coupled to a linearized cold plasma model. In the appropriate parameter range, the results are in essential agreement with the work of Lovelace and Sudan, but encompass a broader parameter range. It is noted that the condition usually stated for the validity of the linearized plasma dynamics, beam density (n_b) $\ll$ plasma density (n_p), is insufficient. Instead, the much more restrictive condition, $n_b/n_p \ll \nu_c/\omega_p$, is required, where ν_c and ω_p are the plasma-electron collision frequency and plasma frequency, respectively. (auth)

11975 (SAN-799-X-1) RESEARCH INTO AND USE OF COMPUTER MODELS OF PLASMAS IN CONTROLLED THERMONUCLEAR RESEARCH. Progress Report, December 1, 1972–April 30, 1973. Buneman, O.; Barnes, C. (San Francisco Operations Office (AEC), Calif.). 1973. Contract AT(04-3)-799. 2p. Dep. NTIS $3.00.

Research progress in the area of data management and volume of computing and also in the area of algorithms or codes is briefly described. (MOW)

11976 MAGNETOHYDRODYNAMIC SIMULATION OF TOROIDAL BELT PINCH EXPERIMENTS. Hofmann, F. (Centre de Recherches et Physique des Plasmas, Lausanne, Switzerland). Nucl. Fusion; 13: No. 2, 297-299(Mar 1973).

Current interest in toroidal high-beta devices of the "belt" variety has been spurred by the recent discovery that such configurations may be stable at much higher beta values than are possible in conventional toroidal screw pinches with circular plasma cross section. It is believed that the early evolution of a belt-pinch plasma is essentially a one-dimensional process that can be computed quite accurately, using a one-dimensional MHD-code in cylindrical geometry. The applicability and the limitations of such a model are discussed. (MOW)

11977 NONPHYSICAL SELF FORCES IN SOME ELECTROMAGNETIC PLASMA-SIMULATION ALGORITHMS. Boris, J. P.; Lee, R. (Naval Research Lab., Washington, DC). J. Comput. Phys.; 12: No. 1, 131-136(May 1973).

A simple algorithm is described for removing nonphysical self forces from two popular electromagnetic plasma simulation models. This algorithm also has two additional features; it is expected to reduce short-wavelength noise and unwanted numerical fluctuations and permits faster integration of the particle orbit equations by roughly a factor of two. (MOW)

11978 INVERSION OF THE HELMHOLTZ (OR LAPLACE–POISSON) OPERATOR FOR SLAB GEOMETRY. Buneman, O. (Stanford Univ., CA). J. Comput. Phys.; 12: No. 1, 124-130(May 1973).

A convenient method is presented for determining static or propagating fields due to a slab-confined source distribution. The propagating version was developed with a view to studying thin plasma layers. The static version has been in use for several years to study anomalous plasma diffusion or electrostatic sheath problems. (MOW)

11979 STATISTICAL THEORY OF A NONIDEAL PLASMA. Zelener, B. V.; Norman, G. E.; Filinov, V. S. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 6, 1043-1052(1972.

Translated from Teplofiz. Vys. Temp.; 10: No. 6, 1160-1170 (1972).

A model of a partially ionized nonideal plasma is proposed. The interaction of ions with continuous-spectrum electrons is described by means of the effective pair potential (pseudopotential). Atoms are treated separately as an ideal gas subject to the condition of ionization equilibrium between the atoms and the subsystem of charged particles. Similarity relations are derived between the thermodynamic variables for various temperatures and various chemical elements. The Monte Carlo method is used to calculate the equations of state and ionization equilibrium over a wide range of values of the nonideality parameter $\gamma = e^2(n_e + n_i)^{1/3}/kT$. The restricted applicability of the Debye–Hueckel limiting law is discussed for the weakly nonideal case. The resulting equation of state concurs with the existing experimental data for the domain in which $\gamma \lesssim 1$. (auth)

11980 RELATIVISTIC-PHASE SELF-FOCUSING OF ELECTRONS IN THE HF-SUPPLEMENTED MAGNETIC MIRROR AT ECR. Golovanivsky, K. S. (Patrice Lumumba Univ., Moscow). Phys. Lett., 44A: No. 3, 190-192(4 Jun 1973).

The evolution in time of phase shift between an hf electric field and the perpendicular velocity of an electron–ion coupled pair in the ecr zone of the combined mirrors is analyzed. The conditions under which the combined mirror is reversible are determined. (auth)

11981 INITIAL-VALUE PROBLEM FOR A NONLINEAR SYSTEM OF VLASOV–MAXWELL EQUATIONS. Duniec, J. (Inst. of Fundamental Technological Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 21: No. 3, 157-162(1973).

An initial-value problem for a one-dimensional relativistic system of Vlasov–Maxwell equations is considered. Under certain conditions regarding initial values, the theorem of local existence and uniqueness of a solution of the initial-value problem is valid. The method used in the proof is based on the contraction mapping theorem; this fact may be useful when performing numerical calculations. (auth)

11982 THEORY OF OPTICAL POLARIZATION MEASUREMENTS OF TURBULENCE SPECTRA IN PLASMA. Sholin, G. V.; Oks, E. A. (Inst. of Atomic Energy, Moscow). Dokl. Akad. Nauk SSSR; 209: No. 6, 1318-1321(21 Apr 1973). (In Russian).

The measurement of the polarization of light within the Stark contour of spectral lines provides information on the spectrum of electrostatic noise in a turbulent plasma. The influence of homogeneous, but anisotropic, low-frequency electrostatic noise on the Stark profile of hydrogen lines was investigated. (KSW)

Production

11983 (LS-255) SELECTED BIBLIOGRAPHY ON PLASMA PRODUCTION BY LASERS. Weil, S. (comp.) (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Jan 1973. 89p. Dep. NTIS (U.S. Sales Only) $6.50.

The 705 items listed cover the years 1969–1972. A very few earlier items and the main coverage for the years prior to 1969 are also included. The compilation is based on two sources: NSA, and the Plasma Physics Index, both for the years 1969–1972. Only bibliographic data are given, without abstracts. The entries are listed alphabetically according to the first author. A key to the abbreviations, an alphabetical index of co-authors, and a subject index are given. (auth)

11984 (UCID-16231) D-T MIRROR REACTOR FUEL CYCLE NOT REQUIRING A LITHIUM BLANKET. Post, R. F. (California Univ., Livermore. Lawrence Livermore Lab.). 21 Mar 1973. Contract W-7405-eng-48. 9p. Dep. NTIS $3.00.

The possibility of operating a mirror fusion reactor involving the injection of deuterium and tritium but not requiring tritium breeding by neutron capture in a lithium-contained blanket is investigated. While breeding of tritium is still required, the removal of the necessity for the use of lithium in the blanket opens up some new possibilities, both for higher-temperature blankets and for new choices of blanket material (e.g., graphite) that could drastically reduce the problem of neutron activation of blanket materials with the accompanying problems of maintenance, replacement, and disposal that characterizes some of the proposed blanket designs. At the same time, the proposed cycle would drastically reduce the inventory of tritium in the reactor, down to almost a level possibly not much in excess of that present in the reactor plasma itself, i.e., to almost a negligible level. The price that would be paid for those gains would be a fairly slight reduction (of order 30%) in the value of "Q" relative to a 50–50 D–T fueled mirror reactor, together with a requirement for higher ion temperature than the minimum usable value for the usual D–T cycle. These disadvantages may be completely outweighed by the major advantages of such a cycle, which relies exclusively on deuterium as its primary fuel as compared to the usual cycle—i.e., D– T + n capture in lithium. (auth)

11985 (UCID-16272) NEW MATERIAL PREPARED FOR PRESENTATION DURING FORTHCOMING EUROPEAN TRIP. Shearer, J. W. (California Univ., Livermore. Lawrence Livermore Lab.). 22 May 1973. Contract W-7405-eng-48. 22p. Dep. NTIS $3.25.

Lists, with texts, of figures and slides prepared for presentation at Culham, England are presented. These deal mainly with laser beam interactions with plasma and associated instabilities. (MOW)

11986 COMPOSITE MACROPARTICLE PROJECTILES AND CONTROLLED FUSION. Pozwolski, A. E. Phys. Lett.; 44A: No. 3, 196-198(4 Jun 1973).

A thermonuclear plasma obtained from collisions with composite macroparticles accelerated to high velocities is considered; here the macro-particles are a mixture of deuterium with uranium. The presence of uranium results in (a) binding forces achieving stability, and (b) superheating. (auth)

11987 LASER INTERACTION AND RELATED PLASMA PHENOMENA. Volume 2. Proceedings of the Second Workshop, Hartford, Connecticut, August 30–September 3, 1971. Schwarz, H. J.; Hora, H. New York; Plenum Publishing Corporation (1972). 595p. (CONF-710853-). $27.50.

Thirty-eight papers are included that deal with the following subject areas: (1) high intensity lasers, (2) laser-induced gas breakdown, (3) plasma diagnostics and special interaction processes, (4) laser-produced plasmas interacting with gases and magnetic fields, (5) theory of high intensity laser interactions with plasmas, and (6) fusion neutrons from laser irradiated high density plasmas. (MOW)

11988 NUMERICAL ANALYSIS OF THE AVERAGED EQUATIONS OF CONCENTRIC LASER CUMULATION OF PLASMA WITH CONSIDERATION OF NUCLEAR FUSION ENERGY. Kaliski, S. (Inst. of Fundamental Technological Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 21: No. 3, 221-226(1973).

A solution, by using analog computers, of equations formulated for concentric compression of plasma via a concentric laser implosion of a thin "heavy" coating is given. A simplified solution, which consists in reduction of interaction of the coating to the initial speed of the reduced D–T plasma mass, is considered. The fundamental equation of the problem and an analysis of a simplification assumption are given. A solution for the completely averaged scheme is presented. (auth)

11989 GENERATION OF LARGE-VOLUME MICROWAVE PLASMAS. Bosisio, R. G.; Wertheimer, M. R.; Weissfloch, C. F. (Ecole Polytechnique, Montreal). J. Phys., E (London); 6: No. 7, 628-630(Jul 1973).

A new technology for producing large volume microwave plasmas is introduced. Microwave energy is coupled into the plasma by means of a slow wave structure, and plasma volumes well in excess of 1000 cm^3 can readily be achieved with 2.5 kW of microwave power at 2.45 GHz. General operating characteristics and some experimental data are presented. (auth)

Stability

Refer also to abstract 11959.

11990 (FRNC-TH-292) COLLISIONAL CYCLOTRON INSTABILITY IN RAMSAUER EFFECT IONIZED GASES. Oddou, C. (Paris Univ. (France)). 1971. 155p. (In French). NTIS (U.S. Sales Only).

Thesis.

Various xenon discharges produced in magnetic fields were studied. Under certain conditions, large low-frequency (approximately 10 kHz) oscillations in the discharge potential occur. These oscillations are accompanied by intense synchronous pulses of microwave radiation in the vicinity of the cyclotron frequency. A special coaxial cavity method was used to detect the radiation. Theoretical and experimental analyses led to the conclusion that these phenomena arise from linear collisional instability and enabled the characteristics of the anomalous cyclotron emission to be established: pulsed characteristics of the radiation associated with the low-frequency oscillations of the discharge, effect of the electron density on the behavior of the anomalous emission and the nature of the instability. A linear macroscopic theory of the ionization waves was used to explain the properties of the low-frequency oscillations and to interpret their nature. The collisional instability is studied, the collective effects and the polarization of the mode being taken into consideration. Calculations effected for a dense plasma are in agreement with experiment and lead to a narrow peak in the emission and absorption of the cyclotron frequency with no specially marked behavior occurring at the hybrid resonance of the mode. (FR)

11991 (LA-UR-73-585) KINK INSTABILITIES IN HIGH-β TOKAMAKS AND BELT PINCHES. Freidberg, J. P.; Haas, F. A.; Marder, B. M. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 5p. (CONF-730705-7). Dep. NTIS $3.00.

It is shown that kink instabilities in a high-β sharp boundary Tokamak ($\beta \sim a/R$) are strongly destabilized by toroidal effects. For either $\beta \sim a/R$ or $\beta \sim 1$ (Belt Pinch), moderate ellipticity has a stabilizing effect on kink modes, whereas large ellipticity is strongly destabilizing. (auth)

11992 (MATT-Trans-111) ROLE OF RUNAWAY ELECTRONS IN THE DEVELOPMENT OF INSTABILITY IN THE TOKAMAK. Alikaev, V. V.; Arsenev, Y. I.; Bobrovskii, G. A.; Kouoratiev, A. A.; Rasumova, K. A. (Institut Atomnoi Energii, Moscow (USSR)). Apr 1973. Translation of IAE-2206. 23p. Dep. NTIS $3.25.

A plasma instability was investigated in the TM-3 device which occurs at low density and a large safety factor and which shows signs of the "disruptive" instability discovered earlier. A study

of plasma x radiation, together with the usual discharge characteristics, was made. These experiments seem to indicate that the plasma column contains an appreciable number of runaway electrons, which play an essential role in the development of the instability. (auth)

11993 (UCID-16268) HOSE THEORY. Lee, E. P. (California Univ., Livermore. Lawrence Livermore Lab.). 16 May 1973. Contract W-7405-eng-48. 139p. Dep. NTIS $9.00.

The theory for the hose instability is presented in the following form: (1) simple continuous beam, (2) simple chopped beam, (3) basic equations for improved models, (4) continuous rigid beam, (5) continuous Vlasov beam, (6) beam in a solenoidal field, (7) wall stabilization, (8) rigid chopped beam, (9) physics for beam simulation code, (10) If limit of hose, (11) sausage mode of a continuous beam, (12) beam expansion, and (13) hose equation for a beam with a gaussian profile. (MOW)

11994 TEMPERATURE-WAVES IN CONNECTION WITH DRIFT-TYPE INSTABILITIES IN A Q-PLASMA. Mueller, G.; Friz, W.; Palmer, R. S. (Aerospace Research Labs., Wright Patterson AFB, OH). Plasma Phys.; 15: No. 5, 411-416(May 1973).

Experimental investigations were made to substantiate the existence of periodic fluctuations of the electron temperature accompanying drift-type instabilities in a Q device. Preliminary results of measurement are reported. For all cases measured, the normalized temperature fluctuations were found to be smaller than the normalized plasma density and floating-potential fluctuations. The experimental results are related to existing theory. (auth)

11995 PARAMETRIC BUILD UP OF SAUSAGE-TYPE OSCILLATIONS BY OSCILLATING CURRENT. Demchenko, V. V.; El-Naggar, I. A.; Hussein, A. M. (Atomic Energy Authority, Cairo). Phys. Lett., 44A: No. 3, 221-222(4 Jun 1973).

It is shown that a plasma column with current $I = I_0 + I_1 \cos(\omega_0 t)$ is unstable with respect to a parametric build-up of "sausage" type oscillations, even on condition that the Kruskal–Shafranov criterion is satisfied. (auth)

11996 EXPERIMENTAL OBSERVATION OF NONLINEAR STABILIZATION OF THE INSTABILITY OF ELECTRON BEAMS IN A PLASMA. Zakatov, L. P.; Kingsep, A. S.; Plakhov, A. G. JETP Lett. (USSR) (Engl. Transl.); 17: No. 6, 201-203(20 Mar 1973).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Red.; 17: No. 6, 201-203(20 Mar 1973).

The beam stabilization in the plasma was observed directly by measuring the longitudinal-energy distribution functions of the beam particles. Two oppositely moving beams were injected into the plasma along the magnetic field. At different fixed currents of the two beams, optimal energy ratios of the stabilizing and test beams were obtained. It was found that the stabilizing effect is most pronounced when the beam energies are nearly equal, and the energy difference does not exceed 1 to 2 keV at a stabilizing-beam energy 13 keV and at currents of 10 A. (MOW)

11997 DECAY INSTABILITY OF BGK WAVES. Demchenko, V. V.; El-Siragy, N. M.; Hussein, A. M. (Atomic Energy Authority, Cairo). Phys. Lett.; 44A: No. 3, 193-195(4 Jun 1973).

Stability of periodical BGK waves of a small (but finite) amplitude is investigated. It is shown that BGK waves are unstable with respect to the "splitting" in a great number of satellite waves. The physical mechanism of the instability and the growth rates of unstable oscillations are examined. (auth)

Thermonuclear Engineering and Equipment

11998 (CONF-730705-4) POLOIDAL FIELD MEASUREMENTS IN THE ST TOKAMAK BY HARMONIC GENERATION AT THE UPPER HYBRID LAYER. Cano, R.; Fidone, I.; Hosea, J. (Princeton Univ., N. J. Plasma Physics Lab.). 1972. 4p. Dep. NTIS $3.00.

A locally generated extraordinary wave with frequency Ω maintains its initial polarization while propagating in a plasma with $\omega_p \ll \omega_c \leq \Omega/2$. This concept was used to measure the direction of the confining magnetic field. The results are described. (MOW)

11999 (EUR-4999) COURSE ON THE STATIONARY AND QUASI-STATIONARY TOROIDAL REACTORS. (European Communities, Luxembourg. Commission). Jun 1973. 489p. Dep. NTIS (U.S. Sales Only) $26.50. EUR B.Fr.500.-.

Twenty-six papers are presented on the scientific and technical feasibility of fusion, energy resources, and strategy of the development of the fusion reactor. (MOW)

12000 (JUL-931-RG) NEUTRONIC STUDIES OF D–T FUSION REACTOR BLANKETS. Brockmann, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Mar 1973. 66p. (In German). Dep. NTIS (U. S. Sales Only) $5.50.

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

Neutronic calculations were performed in order to design the blanket of a D–T fusion reactor. The transport theory has to be applied for the calculations of the neutron economy in a fusion reactor blanket. For that purpose, the numerical method of discrete ordinates and the Monte Carlo method are discussed as they are used in the calculations. Various blanket assemblies with different material compositions are studied with regard to their tritium generation potential, considering new measurements of the (n,2n) cross section of niobium. The importance of this cross section for fusion reactor technology is discussed. The application of beryllium for neutron multiplication is also investigated. Some possible materials of both vacuum wall and structure are compared neutronically. (auth)

12001 (LBL-1589) DESIGN AND OPERATION OF AN INTENSE NEUTRAL BEAM SOURCE. Ehlers, K. W.; Baker, W. R.; Berkner, K. H.; Cooper, W. S.; Kunkel, W. B.; Pyle, R. V.; Stearns, J. W. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-eng-48. 15p. (CONF-730529-1). Dep. NTIS $3.00.

From 12th symposium on electron, ion, and laser beam technology; Cambridge, Massachusetts, USA (21 May 1973).

A neutral beam source capable of producing pulsed deuterium beams of up to 15-A equivalent current at 20 keV for heating and sustaining fusion plasmas is described. It consists of a large-area plasma source, multiple-aperture accel–decel extractor, and closely coupled charge-exchange cell. A larger source, to produce 80-A equivalent deuterium beams at 20 keV, is being constructed. (auth)

12002 (LBL-1782) DESIGN AND OPERATION OF INTENSE NEUTRAL BEAM SOURCES. Baker, W. R.; Berkner, K. H.; Cooper, W. S.; Ehlers, K. W.; Kunkel, W. B.; Pyle, R. V.; Stearns, J. W. (California Univ., Berkeley. Lawrence Berkeley Lab.). 18 Apr 1973. Contract W-7405-eng-48. 5p. (CONF-730705-2). Dep. NTIS $3.00.

Neutral-beam sources to inject up to 50-A equivalent current at 20 keV into mirror plasmas are described. (auth)

12003 MODIFIED LAWSON CRITERION FOR d·^{6}Li-FUELED FUSION REACTORS. McNally, J. R. Jr. (Oak Ridge National Lab., TN). Nucl. Fusion; 13: No. 2, 289-290(Mar 1973).

Recently, ^{6}LiD has been proposed as a nuclear fuel for controlled fusion reactors. It has a larger reactivity parameter, $\sigma v Q_+$, than does a pure d·d reacting system. It is of interest, therefore, to evaluate a modified Lawson criterion, including a minimum $n\tau$, for such plasmas despite the fact that the cross sections are inadequately known and no detailed reaction-kinetics studies have been made. The arguments used here demand a closed magnetic configuration for the reactor system. (MOW)

Wave Phenomena

Refer also to abstract 11994.

12004 (CALT-767-P-2-X-2) PROGRESS REPORT ON PLASMA WAVES. Gould, R. W. (California Inst. of Tech., Pasadena). Mar 1973. Contract AT(04-3)-767. 34p. Dep. NTIS $3.75.

Research summaries are given for the following problems: (1) effect of velocity-space diffusion on the degradation of plasma wave echoes and an experimental determination of the velocity-space diffusion coefficient, (2) thresholds for onset of parametric instabilities, and (3) propagation and absorption of waves near the lower hybrid frequency. (MOW)

12005 OPTIMUM SECOND HARMONIC GENERATION IN INHOMOGENEOUS MAGNETOPLASMA. Singh, A.; Sawhney, R. L. (Indian Inst. of Tech., Delhi). Plasma Phys.; 15: No. 5, 343-352(May 1973).

Analytical expressions are reported for the second harmonic component in the reflected and transmitted waves from an inhomogeneous magnetoplasma slab, having both electron density and temperature gradients, when an electromagnetic wave is incident normally on it. These expressions are used to obtain op-

timum conditions for maximum conversion efficiency of second harmonic generation. (auth)

12006 ACCESSIBILITY TO THE LOWER HYBRID RESONANCE. Puri, S.; Tutter, M. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Z. Naturforsch.; 28a: No. 3-4, 438-442(1973).

Accessibility of a plane electromagnetic wave into an inhomogeneous, magnetized plasma column is studied using the complete cold plasma dielectric tensor. It is found that TM (transverse magnetic) waves incident at small angles with the vacuum–plasma interface are almost completely transmitted into the plasma even though the criterion for accessibility to the lower-hybrid resonance is not satisfied. The significance of this result for coupling rf energy into plasma-filled waveguides is discussed. (GE)

12007 ELECTROSTATIC WAVES WITH FREQUENCIES ABOVE THE GYROFREQUENCY IN A PLASMA WITH A LOSS CONE. Karpman, V. I.; Alekhin, Ju. K.; Borisov, N. D.; Rjabova, N. A. (Izmiran, Moscow). Phys. Lett., 44A: No. 3, 205-207 (4 Jun 1973).

Analytical and numerical results are presented for the propagation and generation conditions of supercyclotronic ($\omega > \omega_c$) electrostatic waves propagating nearly perpendicularly to the magnetic field in a plasma with a loss-cone distribution function. (auth)

12008 EXPERIMENTAL OBSERVATION OF THE EFFECT OF INDUCED TRANSPARENCY OF THE BARRIER TO ELECTRONIC PLASMA WAVES IN AN INHOMOGENEOUS PLASMA. Oraevskii, V. N.; Romanyuk, L. I.; Svavil'nyi, N. E.; Ustalov, V. V. (Inst. of Nuclear Research, Kiev). JETP Lett. (USSR) (Engl. Transl.); 17: No. 6, 207-209(20 Mar 1973).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Red.; 17: No. 6, 288-292(20 Mar 1973).

The passage of waves with frequency below the plasma frequency through a density barrier in an inhomogeneous plasma was observed experimentally. The observed induced transparency of the wave barrier is attributed to transport of the perturbation through the barrier by the particles trapped by the wave. (auth)

12009 INVESTIGATION OF THE REFLECTION OF ELECTROMAGNETIC PULSES FROM MOVING PLASMAS. Rattan, I.; Gautama, G. D.; Chakravarti, A. K. (Indian Inst. of Tech., New Delhi). J. Phys., D (London); 6: No. 8, L87-L90(21 May 1973).

A theoretical investigation of the reflection of electromagnetic pulses (gaussian envelope) from an absorptionless plasma half-space/slab moving perpendicular to the interface has been carried out. It is seen that the nature of the reflected pulse depends strongly on the characteristics of the moving medium. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 11297, 11353, 11653, and 11917.

12010 (BNWL-SA-4533) ENERGY STRAGGLING PARAMETERS FROM SINGLE EVENT SPECTRA. Wilson, W. E.; Toburen, L. H.; Glass, W. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab). 1972. 14p. (CONF-730431-5). Dep. NTIS $3.00.

From annual meeting of the Radiation Research Society; St. Louis, Missouri, USA (29 Apr 1973).

The microdosimetry of protons is studied from the stochastic nature of the energy loss process in very thin absorbers. The stopping power for molecular nitrogen, hydrogen, methane, and benzene bombarded by energetic protons is found. (JFP)

12011 (N-73-15722) ELECTRON TRANSPORT AND SPACE SHIELDING HANDBOOK. Final Report. Shreve, D. C.; Lonergan, J. A. (Science Applications, Inc., La Jolla, Calif. (USA)). 14 Nov 1971. Contract NAS8 26753. 253p. (NASA-CR-123998; SAI-71-559-LJ). NTIS.

The transport of electrons through material is discussed with emphasis on space radiation problems. Brief reviews of the electron radiation environment and electron transport properties are presented. Parametric representations of the electron transmitted fraction, energy spectrum, angular distribution, backscatter coefficient, and energy deposition are given as functions of electron energy and target material. Parametric equations for thick target bremsstrahlung are presented. Calculations of the transport of isotropically incident electrons relevant to space applications are shown. Comparisons of parametric representation with data, photon attenuation coefficients, electron energy deposition data, flux-to-dose conversion relations, and formalism applicable to space shielding problems are presented. (auth)

12012 MOLECULAR STOPPING CROSS SECTIONS OF ALPHA PARTICLES IN BUTANE, PROPANE, ETHANE, NEON, HELIUM, AND HYDROGEN. Wenger, F.; Gardner, R. P.; Verghese, K. (North Carolina State Univ., Raleigh). Health Phys.; 25: No. 1, 67-71(Jul 1973).

Molecular stopping cross sections of alpha particles in butane, propane, ethane and helium for the energy range 1 to 5 MeV and in neon and hydrogen in the range of 2 to 5 MeV are presented. The measurements were made by varying the source-to-detector distance within a chamber containing gas at atmospheric pressure. Measured values for each gas are fitted to a semi-empirical function with two parameters for application in computational models. Results agree satisfactorily with previous measurements on protons and alpha particles in neon, helium, hydrogen and ethane. (auth)

12013 ELECTRON MOBILITY AND LOCALIZATION IN DENSE ^{4}He GAS. Harrison, H. R.; Sander, L. M.; Springett, B. E. (Univ. of Michigan, Ann Arbor). J. Phys., B (London); 6: No. 5, 908-917(May 1973).

An extensive experimental investigation was carried out on the mobility of electrons in dense helium gas with particular emphasis on the drastic decreases in mobility which are believed to result from the onset of electron localization in the fluid. The mobility was measured for gas densities $2 < \rho < 40 \times 10^{20}$ atoms cm^{-3}, and for gas temperatures $4 < T < 300$ K. Refinements of former treatments of electron localization via the bubble model are presented which demonstrate a strong correlation between the mobility edge and a localization criterion. Detailed agreement between theory and experiment is not realized, but the general features of the density and temperature dependence of the mobility are reproduced in a consistent manner. (auth)

12014 BACKSCATTERING OF ^{137}Cs GAMMA RAYS BY FINITE BARRIERS. Elias, E.; Segal, Y.; Notea, A. (Technion-Israel Inst. of Tech., Haifa). J. Nucl. Energy; 27: No. 5, 351-362(May 1973).

Angular differential number and energy albedo were measured at a scattering angle of 60° for narrow beam of ^{137}Cs gamma rays normally incident on finite thickness scattering media of various atomic numbers. Measurements were made using a collimated 3 cm^3 Ge(Li) detector with suitable electronics and a 400 channel pulse-height analyzer. The calculation of the energy spectrum of the scattered photons was carried out by using a response matrix with 51 energy intervals over the range 0.04 to 0.3 MeV. (auth)

12015 PHOTOGRAPHIC METHOD FOR RECORDING ISODOSES THROUGH THE USE OF AGFACONTOUR FILM. Rekonen, A.; Anttila, P.; Laaksonen, S. (Middle Finland Central Hospital, Jyvaskyla). Strahlentherapie; 145: No. 1, 45-50 (1973).

A new photographic method to record isodoses of radiation fields is introduced. The method uses Agfacontour film, where a belt between high and low exposure areas will remain undeveloped. After an x-ray film is exposed in the radiation field, a series of Agfacontour film copies is made of this x-ray film using exposure times having a constant ratio. These films are then copied on normal photographic paper to obtain a complete map of isodoses. The method gives sharp isodose outlines, and it is particularly suitable for recording isodoses in areas of inhomogeneities. (GE)

12016 METHOD FOR THE CALCULATION OF DOSE IN THE RADIATION TREATMENT OF HODGKIN'S DISEASE. Cundiff, J. H. (Univ. of Texas, Houston); Cunningham, J. R.; Golden, R.; (and others) Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 117: No. 1, 30-44(Jan 1973).

A general calculative method is described which uses standard tabular data together with a few measurements on the therapy machine. The dose is separated into primary and scatter contributions with allowances for the variation of exposure across the field and nonnominal source–skin distance in parts of the field. This method can be used to calculate the dose at any point in the patient within or outside the useful beam except near the edges of the field. It may be considered a standard of comparison for approximation methods without further experimental verification. (JFP)

12017 PRELIMINARY RESULTS ON COSMIC RADIATIONS DOSIMETRY MADE ON BOARD A CONCORDE PROTOTYPE. Kaiser, R.; Delahaye, R. P.; Pfister, A.; Depres, S. (Centre National de la Recherche Scientifique, Strasbourg). Rev. Med. Aeronaut. Spatiale; No. 39, 119-121(1971). (In French).

Two types of measurement were made: measurements with ILFORD K. S. emulsion and measurements with STEP photographic dosimeters. The results are presented in tabular form. Only very small doses were measured (between 0.3 and 2.1 millirads for flight latitudes between 43 deg N and 53 deg N). (France)

12018 TEMPERATURE AND ENERGY DEPENDENCE OF THE MINIMUM YIELD IN AXIAL CHANNELING. Kubota, Y.; Ohtsuki, Y. H. (Waseda Univ., Tokyo). Phys. Lett.; 43A: No. 6, 521-522 (23 Apr 1973).

An analytical expression for the minimum yield in axial channeling is obtained using Lindhard theory for the real situation. The temperature and energy dependence agree well with a Monte-Carlo calculation by Barrett, Phys. Rev., B3: 1527(1971). (auth)

Shielding Calculations and Experiments

Refer also to abstract 12011.

12019 (N-72-24728) NUCLEAR RADIATION ANALYSIS. Summary Report. Knies, R. J.; Byrn, N. R.; Smith, H. T. (Teledyne Brown Engineering, Huntsville, Ala. (USA)). Feb 1972. Contract NAS8-26557. 48p. (NASA-CR-123636; SE-SSL-1476). NTIS.

A study program of radiation shielding against the deleterious effects of nuclear radiation on man and equipment is reported. The methods used to analyze the radiation environment from bremsstrahlung photons are discussed along with the methods employed by transport code users. The theory and numerical methods used to solve transport of neutrons and gammas are described, and the neutron and cosmic fluxes that would be present on the gamma-ray telescope were analyzed. (STAR)

PHYSICS (THEORETICAL)

General

12020 (FRNC-TH-304) VARIOUS STUDIES OF THE ELECTROMAGNETIC STRUCTURE OF NUCLEI. Grunbaum, L. (Paris Univ. (France)). 1972. 99p. (In French). NTIS (U. S. Sales Only).

Thesis.

The electromagnetic structure of nucleons was studied using dispersion relations for the nucleon mass. The hypothesis that π-meson exchange has a major contribution to the nucleon electromagnetic form factors was suggested. The results obtained for the magnetic moments, magnetic radii, and electric radii agree very well with experiment. The energy spectra and the inelastic electromagnetic form factors for the positive parity bound levels were calculated for ^{9}Be and ^{13}C using particle-core coupling and the Born approximation. The theoretical results are compared with those obtained from recent experiments on the elastic scattering of electrons. The first levels excited in these two nuclei involve an important magnetic spin contribution having low momentum transfer $q < 0.6$ Fm^{-1}. (FR)

12021 HEURISTIC VALUE OF COMPUTERS IN PHYSICS. Pasta, J. R. (National Science Foundation, Washington, DC). Comput. Phys. Commun., Suppl.; 3: 139-150 (Sep 1972).

The role of the computer as an heuristic tool is contrasted to its use in predictive modeling and engineering design. An example of a one-dimensional system of nonlinearly coupled equimass particles is given and discussed from the point of view of its heuristic content. Next generation computer architecture is examined and it is suggested how computer networks might be used to satisfy the disparate needs in science. (auth)

12022 DEVELOPMENT OF COMPUTER SYSTEMS IN PHYSICS. Zacharov, B. (Nuclear Physic Lab., Daresbury, Eng.). Comput. Phys. Commun., Suppl.; 3: 50-62 (Sep 1972).

In many areas of physics, progress is impeded by the inadequacies of available computer systems. By surveying the kind of problem that is now difficult to solve, it is possible to discern those limitations in computer systems which represent the principal obstacles to computational physics. An attempt is made to list those limitations and to review the progress that is being made to overcome them. (auth)

12023 ASPECTS OF QUANTUM THEORY. Salam, A.; Wigner, E. P. (eds.). Cambridge, MA; Cambridge University Press (1972). 279p. $23.50.

Twelve articles in this volume discuss various aspects of quantum mechanics which owe their origin to the work of P. A. M. Dirac. Each contributor reviews Dirac's work and discusses its subsequent development in some detail. A small part of the book contains personal reminiscences of Dirac in Cambridge and of his early visits to the U. S. A. and gives a historical account of the development of quantum mechanics during the decade 1924-1933. A bibliography of Dirac is also included. The twelve articles are presented under the following titles: Foundation of quantum field theory, by Res Jost; The early history of the theory of the electron: 1897-1947, by A. Pais; The Dirac equation, by A. S. Wightman; Fermi-Dirac statistics, by R. Peierls; Indefinite metric in state space, by W. Heisenberg; On bras and kets, by J. M. Jauch; The Poisson bracket, by C. Lancios; La "fonction" δ et les noyaux, by L. Schwartz; On the Dirac magnetic poles, by E. Amaldi and N. Cabibbo; The fundamental constants and their time variation, by F. J. Dyson; On the time-energy uncertainty relation, by E. P. Wigner; and The path-integral quantization of gravity, by A. Salam and J. Strathdee. (LBS)

Quantum Field Theories

Refer also to abstracts 11692 and 12039.

12024 (DESY-73/6) INFRARED SINGULARITIES AND SMALL DISTANCE-BEHAVIOR ANALYSIS. Symanzik, K. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar 1973. 59p. Dep. NTIS (U.S. Sales Only) $5.00.

The infrared-singularity structure of the vertex functions of massless-particle ϕ^4 theory is studied. This allows one to construct the asymptotic forms of the vertex functions of massive-particle ϕ^4 theory in a simpler and more explicit fashion than previously. With the help of the parquet approximation introduced by Diatlov, Sudakov, and Martirosian it is shown that the infrared-singularity structure in a theory with besides the massless particles, massive ones is the same as in the theory with massless particles only. All these results in ϕ^4 theory have analogs in other renormalizable theories. (auth)

12025 (JINR-E2-7045) PRESENT STATUS OF QUANTUM FIELD THEORY. Blokhintsev, D. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 23p. (CONF-730435-1). Dep. NTIS (U. S. Sales Only) $3.25.

Present status of nonlocal quantum field theory is reviewed. (auth)

12026 BOSON FIELDS WITH THE $\lambda\Phi^3$ INTERACTION IN TWO, THREE, AND FOUR DIMENSIONS. Osterwalder, K. Diss. No. 4462. Zurich; Eidgenoessische Technische Hochschule (1970). 130p.

Thesis.

The $\lambda \int : \phi^3(x) : h(x)\, dx$ interaction is considered for boson fields in 2, 3, and 4 dimensional space time. The function h(x) provides a space cut off. It is shown that the renormalized Hamiltonian H_{ren} exists as densely defined symmetric operator, which is not bounded from below. (auth)

12027 QUANTUM THEORY OF THE POLARIZED VACUUM. Bagge, E. (Univ., Kiel). Atomkernenergie; 21: No. 1, 36-40 (1973). (In German).

Starting with the Lagrangian density of the electromagnetic field for a polarized vacuum without charges and currents the canonical conjugated variables of this field and the Hamiltonian energy-density are determined. On the basis exchange relations for the space- and momentum-variables of this field are defined and in this way two types of quanta appear in this theory. The usual field quanta, also exist, if there are no polarization effects and the polarization quanta, produced by the polarization effects of the vacuum, have a negative value in the expression for the whole field energy. The negative sign of these quanta has the consequence that in the quantized electrodynamics of the polarized vacuum the total field energy becomes finite, if the number of occupied states is limited, in contrast to current quantum-electrodynamics on the basis of Maxwell's theory. (auth)

12028 SPINORS, SEMI-SPINORS, AND THE FIELD OF FREE SPIN 3/2 PARTICLES IN GENERAL RELATIVITY. Claire, R. (Institut Universitaire de Technologie, Aubiere, France). Compt. Rend., Ser. A, 276: No. 9, 715-718 (26 Feb 1973). (In French).

A formalism is presented for semi-spinors and the Fierz-Pauli equations that are deduced from a Lagrangian in the framework of general relativity. Comparisons are made with the Rarita-Schwinger equations. (FR)

12029 PADE-APPROXIMATION AND SOME MODELS IN QUANTUM FIELD THEORY. Kleskov, V. I. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 1, 8-14 (1973). (In Russian).

It is possible to select Pade-approximations of lower orders in field theory for some models with a fixed source. These approximations construct from the first members of the series for amplitudes of these models solutions to the Laue dispersion equations. (tr-auth)

12030 ROLE OF AN INDEFINITE METRIC IN THE STATE SPACE OF QUANTUM FIELD THEORY. Duerr, H. P. (Max-Planck Institut fuer Physik und Astrophysik, Munich). Z. Naturforsch. 28a: No. 3-4, 346-353 (1973). (In German).

The necessary extension of the quantum mechanical Hilbert space to a state space with indefinite metric in a local description of quantum electrodynamics, the Yang-Mills theory and a linearized gravitation theory is illustrated. As one of the essential physical consequences of such an extension the fact that the interaction cannot be completely represented by the virtual exchange of particles but always does contain nonparticle-like "genuine" parts of nonlocal character is emphasized. In analogy to these cases the indefinite metric in Heisenberg's Lee model and in subcanonical quantum field theories, like Heisenberg's nonlinear spinor theory, is discussed. The physical consequences resulting from a unitarization of these theories with regard to the effective interaction and its causal character are pointed out. (auth)

12031 UNCORRELATED-JET-MODEL PREDICTIONS FOR THE MULTIPLICITY DISTRIBUTION OF π^- MESONS PRODUCED IN HIGH ENERGY ANNIHILATIONS $\bar{p}p \rightarrow$ PIONS. de Groot, E. H. (Oxford Univ.); Zalewski, K. Nucl. Phys.; B57: No. 1, 212-220 (1973).

The uncorrelated jet model is used to obtain a grand partition function for the pions produced in the process $\bar{p}p \rightarrow$ pions. The

grand partition function is evaluated asymptotically for large energies. It is used to relate the correlation parameter $f_2 = \langle n^2 \rangle - \langle n_- \rangle^2 - \langle n_- \rangle$ to the average multiplicity of negative pions $\langle n_- \rangle$. The results are consistent with the presently available experimental data, though data at higher energies are necessary to draw physically interesting conclusions. (auth)

Gravitation and General Relativity

Refer also to abstracts 11684, 11729, 12028, and 12030.

12032 (DESY-73/10) MODEL OF LINEARIZED DEVIATIONS IN THE QUANTUM THEORY OF GRAVITY. Tarski, J. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Apr 1973. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

Linearized deviations from two kinds of hypersurfaces of a de Sitter universe are considered. Ground state functionals of these deviations are determined. The approach is the one used by Kuchař in his study of the linearized gravitational field. (auth)

12033 SOME ALGEBRAICALLY SPECIAL SOLUTIONS OF EINSTEIN'S EQUATIONS. I. Vaidya, P. C. Tensor; 25: 315-321(1972).

The elementary mathematic methods of previous particular solutions are used to obtain very general solutions of the Einstein equations. The metric is used in the Kerr-Schild form. A very general form of the tangent vector to a geodesic shear-free null congruence in a flat background is used, and the conditions for the congruence to be geodesic and shear-free are found. (JFP)

12034 EINSTEIN AND TENSORS. Hoffmann, B. (Queens Coll. of New York). Tensor; 25: 157-162(1972).

Starting from the principle of equivalence, some aspects of Einstein's intellectual journey toward the use of tensors in the general theory of relativity are discussed that are relatively unfamiliar because theory is not visible from studying the papers reprinted in The Principle of Relativity. (JFP)

12035 ELECTROMAGNETIC THEORY IN GENERAL RELATIVITY. II. NON-SINGULAR FIELDS. Debney, G. C.; Zund, J. D. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Tensor; 25: 53-62(1972).

Nonsingular source-free electromagnetic fields are discussed, and various results concerning the Lie derivatives of the electromagnetic energy-momentum and field tensors are given. The Newman-Penrose version of the Einstein field equations is included. (JFP)

12036 ELECTROMAGNETIC THEORY IN GENERAL RELATIVITY. I. THE GEOMETRY OF CONGRUENCES. Debney, G. C.; Zund, J. D. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Tensor; 25: 47-52(1972).

The analytical and geometric pre-requisites for the complex null tetrad and congruences of null curves which will be required in a subsequent investigation of electromagnetic theory within the framework of general relativity theory are developed. (JFP)

12037 ACAUSAL GEODESICS IN THE REISSNER-NORDSTROEM GEOMETRY. Brigman, G. H. (Bell Helicopter Co., Fort Worth, TX). Tensor; 25: 267-286(1972).

The principle of casuality is discussed for the case in which the pinchoff of the wormhole blocks a channel of communication that would otherwise violate casuality. The idealized geometry has spherical symmetry which is described by the Reissner-Nordstroem solution of Einstein field equations, the generalization of Schwarzchild's solution to the case where charge as well as mass is present. (JFP)

12038 QUADRATIC FIRST INTEGRALS IN THE GENERAL RELATIVISTIC KEPLER PROBLEM. Ikeda, M.; Kimura, M. (Kyoto Univ.). Tensor; 25: 395-404(1972).

The quadratic first integrals for the Schwarzchild space-time are obtained. A brief mention is also made of the relation between the linear and quadratic first integrals. (JFP)

12039 UNIFIED FIELD THEORIES OF EINSTEIN'S TYPE DEDUCED FROM A VARIATIONAL PRINCIPLE: CONSERVATION LAWS. Santalo, L. A. (Univ., Buenos Aires). Tensor; 25: 383-389(1972).

Some complements of the general theory of Einstein unified theory are given, and the conservation laws or conservation identities are established which are satisfied for any set of variables (Γ^i_{jk}, g_{ij}) which satisfies the field equations. (JFP)

12040 CYLINDRICAL WAVE SOLUTIONS OF GAUGE-INVARIANT GENERALIZATION EQUATIONS OF FIELD THEORIES WITH ASYMMETRIC FUNDAMENTAL TENSOR. II. Lal, K. B.; Singh, T. (Univ. of Gorakhpur, India). Tensor; 25: 217-223 (1972).

The field equations of a guage-invariant theory based on an asymmetric covariant tensor and a covariant vector relating these to an asymmetric linear connection are considered in a cylindrically symmetric space-time having the element $ds^2 = -Ad\phi^3 - Bdz^2 - Cdr^2 + Cdt^2$. (JFP)

12041 SCALAR-TENSOR FIELD THEORIES. Horndeski, G. W.; Lovelock, D. (Univ. of Waterloo, Canada). Tensor; 25: 79-92(1972).

In view of the interest in the Brans-Dicke theory together with the Bergmann conjecture a detailed analysis is given of the Lagrange densities of the type $L = L(g_{ij}; g_{ij,k}; g_{ij,kh}; \phi; \phi_i)$, where the Lagrange density L is a function of a symmetric metric tensor field g_{ij} and its first derivatives $g_{ij,h}$ and $g_{ij,hk}$ and a scalar field ϕ and its first derivatives ϕ_i. (JFP)

12042 ALBERT EINSTEIN CREATOR AND REBEL. Hoffmann, B.; Dukas, H. London; Hart-Davis, MacGibbon (1973). 272p.

An account is given of the life and work of Einstein, including discussions of quantum mechanics, photoelectric effect, general relativity theory, space-time, gravitation, Einstein field equations, the equivalence of mass and energy, stimulated emission, Bose-Einstein statistics, cosmological models, unified field theory. (UK)

12043 TWO-DIMENSIONAL SURFACES IN THE GENERAL THEORY OF RELATIVITY. Polishchuk, R. F. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 1, 3-7(1973). (In Russian).

A diad formalism was advanced for describing two-dimensional distributions within the framework of the general relativity theory. The concepts of induced external differentiation, an induced group of motion for a Rieman distribution, the homogeneity of the latter (including physical space), and the genera of space-time are described. Equations were written for gravitational diffusion and wave processes with the air of an induced d'Alembertian. The diad formulation of Einstein's equations and laws of conservation are given. (tr-auth)

12044 AUTOPARALLEL AND GEODESIC CURVES IN A GENERALIZED CASE. Jankovic, Z. (Rudjer Boskovic Inst., Zagreb). Tensor; 25: 171-178(1972).

Since autoparallel and geodesic curves have an important role in differential geometry and its field of application such as general relativity theory, these curves are studied in the frame of a generalized scheme recently developed, and the circumstances under which they become identical are investigated. (JFP)

12045 PECULIAR COMBINED NEUTRINO-f-g GRAVITY FIELD. Aichelburg, P. C. (Univ., Vienna). Phys. Lett.; 44B: No. 4, 370-372(14 May 1973).

An exact non-vacuum solution to Salam's f-g two-tensor theory of gravitation is given. The source, a leptonic massless spin $\frac{1}{2}$ radiation field couples to only one of the gravitational fields. Strangely, this field nevertheless remains flat, while the source-free field is curved. (auth)

REACTOR TECHNOLOGY AND REGULATION

12046 (EUR-4820(Vol.1)(Pt.A-B)) PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY, BERLIN, GERMANY, 20–24 SEPTEMBER 1971. Vol. 1. Survey of the Conference Reactor Technology. Part A. General Lectures. Part B. Power Reactor Development and Structural Mechanics. Jaeger, T. A. (comp.). (European Communities, Brussels (Belgium). Commission; Bundesanstalt fuer Materialpruefung, Berlin (West Germany)). Mar 1972. 228p. (In German and English). (CONF-710903-(Vol.1)(Pt.A-B)). EUR.

Papers are presented on scientific information systems and reactor development programs. Separate abstracts are included for 2 of the 9 papers presented. Seven of the papers have been previously abstracted and included in NSA. (DCC)

For abstracts of individual papers see: 12047 and 12048.

12047 (EUR-4820(Vol.1)(Pt.A-B), pp 101-103) ON THE DISSEMINATION OF SCIENTIFIC INFORMATION. Part I. The Role of the European Community in Disseminating Knowledge. Bree, R. (Commission of the European Communities, Luxembourg). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The European Community has clearly defined responsibilities for disseminating knowledge originating with its activities in the field of nuclear research and development. The extent and the significance of the dissemination of knowledge as exerted by the services of the Community are described with special regard to the emphasis given to improving the access to nuclear information by creating the Euratom Nuclear Documentation System, which is encompassing more than 1.2 million data on nuclear literature and, on the other hand, to sponsoring of and participating in conferences on selected topics and publishing their proceedings. (auth)

12048 (EUR-4820(Vol.1)(Pt.A-B), pp 105-114) ON THE DISSEMINATION OF SCIENTIFIC INFORMATION. PART II. A Computerized Nuclear Information System Faces Its Customers. Vernimb, C. (Commission of the European Communities, Luxembourg). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The Euratom Nuclear Documentation System has gradually improved over the years, largely thanks to customer "feed-back." The customer today still needs an expert documentalist to act as an "interpreter" between himself and the system. Further improvements will however soon enable him to converse directly with the computer. 7 references. (auth)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 12128, 12174–12178, 12185, 12195–12210, 12219, 12220, 12222–12225, 12238–12245, 12252–12258, 12272–12278, 12289–12300, 12310–12312, 12314–12318, 12347, 12356, 12360, 12374, 12378, 12380–12387, 12413, 12414, 12417–12422, 12425–12427, 12431–12433, 12438–12447, 12453–12456, and 12467–12469.

12049 (EUR-4820(Vol.6)(Pt.M), pp 409-424) APPLICATION OF FINITE ELEMENT METHOD TO THE THREE-DIMENSIONAL STRESS AND VIBRATION ANALYSIS OF BWR PRIMARY PLANT SYSTEMS. Mizumachi, W. (Tokyo Shibaura Electric Co.). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The material non-linear stress analysis and the vibration analysis for the boiling water reactor (BWR) plant by a three-dimensional finite element method are presented. This method is very useful for both analyses. However the big problem is to solve the large matrix whose order is, say 10,000 × 10,000 to 100,000 × 100,000 (the author calls it the Jumbo Matrix). It becomes so large because not only the shapes of the structures but the load and boundary conditions in the BWR plant are very complicated. The following two methods have been used in order to analyze such complex system: direct method from element matrices using the conjugate gradient method; and the band-width method. The three-dimensional finite element method gives good results by these methods. The band width method is omitted here because it is well-known. (auth)

12050 (NEDC-10586) PLUTONIUM UTILIZATION IN BOILING WATER REACTORS. Phase II Semi-Annual Report, January–June 1971. (General Electric Co., San Jose, Calif. Nuclear Fuels Dept.). Dec 1971. 116p.

For Edison Electric Inst., New York.

Progress is reported on the joint EEI/GE program for utilization of plutonium in boiling water reactors for the period January–June 1971. Big Rock Point reactor irradiation performance results are reported for $^{28}PuO_2-UO_2$ fuel rods and three all PuO_2-UO_2 fuel rod bundles. Hot cell examination results are reported for four rods removed from Big Rock Point in February 1970 after one cycle of irradiation. Vermont Yankee design finalization and fuel fabrication for four recycle demonstration fuel bundles are reported and plans for pre-irradiation characterization and bundle assembly are described. Activities associated with the AEC-sponsored Integrated Safeguards Experiment and Plant Instrumentation Program are reported. The plutonium recycle design optimization and economic studies are summarized. A plutonium methods seminar was held for EEI member utilities. Included were a general review of BWR Pu recycle analysis methods, special Pu fuel analysis problems, BWR experimental information backup and comparisons of theory and experiment and comparisons between alternate theoretical methods of differing degrees of sophistication. There were 20 utility participants and there was open and frank discussion on utility problems in nuclear analysis of power reactors. Safeguards and licensing analyses of the Vermont Yankee assemblies continued to indicate that the prototypical production BWR Pu recycle fuel met all AEC criteria for reactor safety. In response to licensing submittals, the AEC indicated that there was insufficient time to evaluate introduction of these assemblies. This decision was a major setback to the modern fuel assembly irradiations, requiring consideration of alternate power reactor irradiation sites. The significant conclusions or observations of the program to date are that (a) the test irradiations are proceeding successfully with no failures and peak burnups of 22,000 MWd/MT; (b) the interchangeable plutonium recycle bundle design objective has been accomplished with acceptable performance, economics, and safety; (c) the annular fuel pellet concept continues to show promise as the most economical design for plutonium recycle in boiling water reactors. Studies have indicated that interchangeable plutonium recycle fuel assemblies can be used to replace, or be intermixed with, conventional uranium reloads without affecting the control system; that plutonium quantities in excess of that generated in the BWR can be recycled, and that plutonium discharged from other reactor types can be recycled in the BWR. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 12126, 12128, 12147, 12169–12173, 12181–12184, 12188–12194, 12211–12219, 12221, 12226–12237, 12241, 12246–12251, 12259–12271, 12279–12282, 12285–12288, 12301–12309, 12313, 12319–12346, 12348–12355, 12357–12359, 12361–12373, 12375–12377, 12379, 12388–12412, 12415, 12416, 12423, 12424, 12428–12430, 12434–12437, 12448–12452, and 12457–12466.

12051 (CENPD-55(Rev.1)) ANALYSIS OF FLOW-INDUCED VIBRATIONS: MAINE-YANKEE PRECRITICAL VIBRATION MONITORING PROGRAM. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Power Dept.). Feb 1973. 60p.

The methods of analysis used to predict the hydraulic forcing functions and the resulting vibratory response in the Maine Yankee reactor are presented along with the results of the analysis. (JWR)

12052 (EUR-4820(Vol.6)(Pt.M), pp 119-135) UNIQUE APPLICATION OF INSTRUMENTATION FOR VERIFICATION OF DESIGN LOAD CONDITIONS AND ASSESSMENT OF RELIABILITY OF IRRADIATED REACTOR INTERNALS. Keller, H. W.; Manjoine, M. J. (Westinghouse Electric Corp., Pittsburgh). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Verification of design load conditions on modified irradiated

reactor internals was performed using a unique application of instrumentation and test procedures. The instrumentation consisted of strain-gaged instrumented core support structure bolting, displacement transducers, nuclear noise analysis, accelerometers, mechanical displacement indicators (scratch gages), and specially developed direct method of verification of fatigue strength of bolting. The test included reactor pre-operational, operational, and post-operational inspection and measurements. All instrumentation performed as intended and the measurements were in good agreement with predictions. (auth)

12053 (EUR-4827) TRINO VERCELLESE NUCLEAR POWER PLANT RESEARCH PROGRAMME FOR THE DEVELOPMENT OF CLOSED-CYCLE WATER REACTOR TECHNOLOGY. Annual Progress Report No. 5; Quarterly Progress Report No. 20. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). Apr 1973. 68p. Dep. NTIS (U. S. Sales Only) $5.50. EUR B.Fr. 70.-.

A description of the research work performed on the TRINO VERCELLESE Nuclear Power Plant in the period July 1st, 1970-June 30th, 1971, under ENEL-EURATOM Contract No 071-66-6 TEEI (R & D) as amended is presented. During this period the core accumulated an incremental burnup of 7358 MWD/MTU and the plant produced 2.021 billions of kWh. The average capacity factor over the entire year was 90.2%. The plant was operated at reduced power in the following periods: 4-16 July 1970 (repairs on TG unit no. 1); February 27-April 5, 1971 (auxiliary generator outage). (auth)

12054 (EUR-4922) ARDENNES NUCLEAR POWER PLANT. Annual Report, 1971. (Societe d'Energie Nucleaire France-Belge des Ardennes, Chooz-lez-Givet (France)). May 1973. 42p. (In French). Dep. NTIS (U. S. Sales Only) $4.25. EUR FB 60,-.

During January 1971 the Ardennes Nuclear Power Plant continued to operate at its nominal rating of 825 MW(t), which corresponds to a net electrical output of 245 MW. After the agreement of the CIAS and the AFW group of constructors had been obtained in late January 1971, plant output was stretched to 905 MW(t), i.e., 270 MW(e) net, on 3 February. Apart from the two months' shutdown required for the refuelling of a third of the core and a further inspection of the repairs carried out during 1968-69, this level of output was maintained throughout the year, giving an excellent availability factor. After the plant had been started up again, some adjustments became necessary as a result of modifications carried out during the summer shutdown, which was aimed at improving the reliability of certain reactor safety systems. Their favorable repercussions on plant reliability became clear at the end of the year. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 10685, 10773, 10805, 11174, 11177, 12186, 12187, 12283, and 12284.

12055 (AEEW-R-832) METHODS FOR THREE-DIMENSIONAL FUEL MANAGEMENT STUDIES ON HIGH TEMPERATURE REACTORS. Askew, J. R.; Anderson, D. W.; Pearson, K. G. (Atomic Energy Establishment, Winfrith (England)). Oct 1972. 18p. Dep. NTIS (U. S. Sales Only) $3.00.

Methods for studying fuel management in High Temperature Reactors have been developed in the UK by extending techniques already applied to the earlier AGR systems. The more severe modelling problems of the new system have demanded innovations to retain the desired accuracy, and improved coarse mesh finite difference algorithms, spectrum models for data condensation to few groups and novel iterative strategies for solving for control rod positions are described. Together they give a rapid 3-dimensional power solution of acceptable accuracy. (auth)

12056 (EUR-4820(Vol.6)(Pt.M), pp 71-92) EXPERIMENTAL AND THEORETICAL INVESTIGATION ON PROBABILISTIC CRITERIA FOR THE MECHANICAL RESISTANCE OF GRAPHITE STRUCTURES. Amesz, J.; Lanza, F.; Volta, G. (Euratom, Ispra, Italy). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The aim of the study is to evaluate the application of probabilistic criteria for the definition of the mechanical resistance of graphite structures. A particular type of industrial graphite "Pechiney L" has been chosen as a "model" material. With relation to the resistance distribution in a graphite column of standard production, the density and the dimensions of the pores have been considered as physical parameters. In order to evaluate the statistical distributions of these parameters a large number of specimens has been investigated. In the same way the statistical distributions of the resistance for tension, compression, and bending have been evaluated. The influence of the specimen dimensions on the foregoing data has been studied with relation to "volume" effect and "section size" effect. For extrapolation of the obtained results on small specimens to structures of larger volumes (10^2-10^4), simple models like "weakest-link" model seem to be insufficient. Some more complex models based on stochastic processes have been considered. (auth)

12057 (EUR-4820(Vol.6)(Pt.M), pp 261-286) FINITE ELEMENT MATRIX DISPLACEMENT METHODS FOR TIME-DEPENDENT STRESS ANALYSIS OF REACTOR MATERIALS IN TWO AND THREE DIMENSIONS. Jezernik, A. (Central Electricity Generating Board, London); Alujevic, A.; Head, J. L. Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A time-dependent stress analysis of some reactor materials by comparative matrix displacement methods is presented. A viscoelastic step-by-step model was used and is derived for two- and three-dimensional analyses. The solution is advanced in small quasi-steady time intervals, however the reactor parameters and material data vary in time and space. The validity of this approach when extended for use in the finite element method was confirmed by comparison with earlier analytical one-dimensional numerical integration codes and experimental evidence. For time-dependent stress analysis of reactor components, the accuracy of the method, as well as the required computer memory and computing time, becomes an important consideration since the repeated use of the finite element procedure and the computer round-off errors at each time step may influence the stability of results. The matrix displacement methods currently used to solve different structural problems in nuclear reactor engineering use various solution techniques as Gauss-Seidel iteration, direct triple-band and frontal approaches. By solving several complex two-dimensional stress problems the relative suitability of different methods is analyzed, results compared, and some conclusions are drawn. Results are presented for generalized plane strain and axisymmetrical 2-dimensional cases for components made of graphite and UO_2. The stress/time history in multichannel graphite blocks under temperature and damage fast neutron flux tilt with 19 holes in pentagonal and hexagonal shapes is presented and the overall distribution and buildup of stresses in the critical regions and in ligaments studied using coarse and fine meshes. Next, the stress against time in the graphite sleeves and coated particle fuel cartridges of a tubular fuel pin (hollow rod) under temperature and flux tilt are given. Stresses/time in graphite blocks and in the tubular fuel pin are calculated for the reactor at power (operating stresses) and reactor shut down (residual stresses). Further in an axisymmetrical case the radial and longitudinal displacements of a UO_2 pellet and stainless steel canning are examined in order to determine the axial dishing. A qualitative analysis of the above 2-dimensional results is performed and some conclusions regarding the design of a nuclear reactor core are drawn. The outline of the 3-dimensional time-dependent code is given and two typical examples for its application, the teledial fuel element end caps and a reactor concrete pressure vessel, are discussed. Finally the possibility of extension of step-by-step model to calculate stresses in some other reactor materials for which different flow rules as time hardening and strain hardening apply and again in parallel the suitability of use of various solution techniques are discussed. (auth)

12058 (ORNL-TM-3039) MSRE SYSTEMS AND COMPONENTS PERFORMANCE. Guymon, R. H. (ed. and comp.) (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 422p. Dep. NTIS $23.25.

When the MSRE was shut down in December 1969, it had accumulated 13,172 full-power hours of operation. Salt had been circulated in the fuel systems for 21,788 hours and in the coolant system for 26,076 hours. Essentially no difficulty was encountered with the primary system during operation. After the reactor was shut down there was an indication of a leak in the drain-tank piping at/or near a freeze valve. Further investigation will be made as to the nature and cause of this leak. There was a small continuous leakage of lubricating oil into the fuel pump throughout the operation. This, together with salt mist, caused periodic plugging in the off-gas system which was designed for clean helium. Filters installed in the main lines proved very effective. In early operation, difficulty was encountered with the coolant radiator. The doors would not seal, there were too many air leaks, and thermal insulation was inadequate. After these were repaired, the system operated fine except for a failure of one of the main blowers and some trouble with the blower bearings. Only relatively minor difficulties were encountered with the containment and other systems. (auth)

12059 (RD/B/N-2461) USE OF A SIMPLE MODEL TO PREDICT REGIONAL SOUND PRESSURE LEVELS IN COMPLEX GAS CIRCUIT GEOMETRIES. Hammill, W. J. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Nov 1972. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

In order to predict the response of gas circuit components of acoustic excitation it is necessary to determine regional sound pressure levels around the gas circuit. The idealisation of such a system in terms of particular types of acoustic field, and the use of coupling terms to determine transmission of noise from one region to another are considered. In particular the transmission characteristics of a narrow cylindrical duct are examined both theoretically and experimentally. It is concluded that an experimental technique could be used to determine the transmission characteristics of elements not amenable to calculation. The use of either theoretically or experimentally derived values of the transmission coefficients of such coupling elements can then be used to determine acoustic power flow between the reactor cavities. (auth)

12060 (RD/B/N-2567) EQUILIBRIUM PARTIAL PRESSURES OF IMPURITY GASES IN THE HELIUM COOLANT OF A HIGH TEMPERATURE GAS-COOLED REACTOR. Hill, A. C.; Hales, R. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Feb 1973. 37p. Dep. NTIS (U. S. Sales Only) $4.00.

The effect of a leakage of water into the core of a high temperature gas-cooled reactor is considered. By reaction of the water with the graphite in the core further impurity gases are generated and an equilibrium gas mixture is established. The result of a temperature change upon the gas mixture is examined from two points of view to determine the possibility of sooting occurring. The equations derived to describe these situations are solved by computer programs as successive approximation methods have to be used. (auth)

12061 GAS TURBINE INSTALLATION UTILIZING THE ENERGY OF A NUCLEAR REACTOR. Maillet, E. (to Commissariat a l'Energie Atomique). French Patent 2,128, 068. 20 Oct 1972. Filed date 3 Mar 1971. 6p. (In French).

A gas turbine installation is described which is directly operated (in an original manner) by the coolant fluid of an integrated nuclear reactor in a specially adapted vessel functioning at reduced pressure or in an annex to the vessel containing the reactor. The machines and the heat exchangers are positioned in parallel horizontal tunnels (preferably three such tunnels) which are situated at approximately the same level and are symmetric in relation to the medium plane of the reactor. The tunnel assembly is in the form of a flat vessel forming a base or an additional part of the reactor or is in the form of a floor of a monolithic vessel. (FR)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstract 12167.

12062 (AECL-4427) AECL RESEARCH AND DEVELOPMENT IN ENGINEERING. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Win 1972. 24p. Dep. NTIS (U. S. Sales Only) $3.25 AECL $1.00.

Separate abstracts were prepared for each of the six papers included. (JWR)

For abstracts of individual papers see: 11125, 12063, 12064, 12167, 12483, and 12491.

12063 (AECL-4427, pp 12-13) PUMPS FOR HEAT-TRANSPORT CIRCUITS IN NUCLEAR STEAM SUPPLIES. Renshaw, R. H. Win 1972.

The heart of the nuclear steam supply system is the heat transport pump. Because a failure of a pump means lost production, AECL continually seeks new concepts to improve the reliability of the heat transport circulating system. Some recent developments are described. (auth)

12064 (AECL-4427, pp 17-21) CURRENT CANADIAN USE OF EXPLOSIVE WELDING FOR REPAIR AND MANUFACTURE OF NUCLEAR STEAM GENERATORS. Dalrymple, D. G. (Chalk River Nuclear Labs., Ont.). Win 1972.

Advances in technology often occur in quantum jumps. One such potential advance is the application of explosive welding to the tube to tubesheet joint in heat exchangers for nuclear service. Applications to PHWR type reactors are described. (auth)

12065 (AEEW-R-791) JOSHUA II: A THREE-DIMENSIONAL, COUPLED NEUTRONICS-HYDRAULICS CALCULATION SCHEME FOR THE WINFRITH SGHWR. Siudek, R. S. (Atomic Energy Establishment, Winfrith (England)). Feb 1972. 46p. Dep. NTIS (U. S. Sales Only) $4.50.

The three dimensional, two energy group, coupled neutronics-hydraulics calculation scheme JOSHUA, has been extended and modified to permit the assessment of the reactor physics and hydraulics performance of the Winfrith SGHWR. These modifications are described, and examples are presented of the use of the new calculation scheme, JOSHUA II, for Winfrith SGHWR calculations. (auth)

12066 (AEEW-R-846) JOSHUA II: A GENERAL WATER REACTOR THREE-DIMENSIONAL COUPLED NUCLEAR HYDRAULIC CALCULATION SCHEME. Harris, D. W. G. (Atomic Energy Establishment, Winfrith (England)). Feb 1973. 70p. Dep. NTIS (U. S. Sales Only) $5.50.

The basic version of the JOSHUA II code written in S2 FORTRAN for the Aldermaston STRETCH computer is given. The work was carried out in 1969 and further versions of the code have subsequently been produced. JOSHUA II is a three-dimensional, two-group diffusion calculation with coupled hydraulics. The flux solution in each neutron group is obtained using a finite difference expansion allied to a source iteration technique, acceleration procedures being used to speed up the solution. A point rating distribution generated from the flux solution is used to advance irradiation values and also to calculate the hydraulics situation in each fuel channel together with associated feeders and risers. A choice of several boundary conditions and control options together with flexible fuel management options are available to the user. A flexible restart facility exists in the code to facilitate restart after each convergence or following an abnormal machine failure. (auth)

12067 EXPERIMENT ON A LARGE THERMAL LOOP. Kobori, T. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Japan). Doryokuro Giho; No. 4, 30-37(May 1972). (In Japanese).

A large-scale (14 MW) experimental thermal loop was constructed at PNC's Oharai Engineering Center, and a series of burnout experiment has been performed for the simulated fuel of FUGEN (Japanese prototype advanced thermal reactor). Outline of experimental facility and results of the experiment are summarized. Maximum permissible pressure, temperature, and flow rate of this facility are 100 kg/cm^2, 310°C and 80 t/h, respectively. Geometry, arrangement, and radial power distribution of experimental fuel rods were all set equal to those in the design of FUGEN. Effects of subcooling, flow rate, steam quality, and pressure on burnout heat flux were investigated. Location of burnout was also investigated, and some examination was carried out on the factors of burnout. These results are being reflected in the core design of FUGEN. Other experiments performed so far are heat-transfer experiment for booster fuel, and transient heat-transfer experiment simulating sudden stoppage of coolant pumps. (JA)

Power Reactors, Breeding

Refer also to abstracts 11128, 11133, 11139, 11140, 11192, 11219, 11241, 11315-11318, 11329, 12134, 12146, 12179, and 12180.

12068 (ANL-7993) PERFORMANCE OF A MIXED-OXIDE FUEL ELEMENT IRRADIATED TO END-OF-LIFE CONDITIONS IN EBR II: SEVEN-ELEMENT TEST IN SUBASSEMBLY X106. Koenig, J. F.; Strain, R. V. (Argonne National Lab., Ill.). Mar 1973. Contract W-31-109-eng-38. 49p. AT $4.00.

Seven mixed-oxide fuel elements were irradiated in special high-risk subassembly X106 until a small cladding defect in one element, ANL-018, allowed part of the stored fission gas in the element plenum to be released to the cover gas of EBR-II. The elements operated to a peak burnup of 7.9 at. % at a peak heat rating of 16 kW/ft, a maximum coolant temperature of 990°F, and a peak cladding temperature of 1100°F. The fission-gas releases, which occurred on three occasions, were mainly characterized by a continuous type of release. The radioactive isotope with the highest release fraction was ^{133}Xe; however, the maximum release of this isotope was less than 0.3% of the inventory formed in the element. The element with the cladding defect could not be identified by visual inspection, but was identified by gamma scanning for ^{133}Xe in the plenum region, by balance-point changes, and by weight changes. No damage was noted on the cladding of the adjacent high-burnup elements. (auth)

12069 (ANL-8008) TENTATIVE DESIGN GUIDE FOR CALCULATING LIQUID-METAL TURBULENT FORCED-CONVECTION HEAT TRANSFER WITH NONUNIFORM HEAT FLUXES AND TRANSIENTS. Minkowycz, W. J.; Stein, R. P. (Argonne Na-

tional Lab., Ill.). Mar 1973. Contract W-31-109-eng-38. 30p. AT $4.00.

Calculation of turbulent forced-convection heat transfer in ducts during nonuniform wall heat fluxes and transients is of interest to the national liquid-metal fast-breeder nuclear-reactor program. An improved method is presented whereby such heat transfer can be determined during analysis and design. Since the method involves the use of fully developed, steady-state heat-transfer coefficients, several dimensionless coefficients and selected physical properties, tables, graphs, or equations are included for the convenience of the designer. Application of the improved method is specialized to four geometries of interest: circular tube, parallel-plate channel, annular space, and approximation of a pin or rod bundle. In addition, three specific examples are calculated in detail. (auth)

12070 (EURFNR-1084) INVESTIGATIONS INTO THE LONG-TERM BEHAVIOR OF SUPPORT POINTS ON A MODEL FUEL ELEMENT FROM CLADS WITH SIX INTEGRAL HELICAL SPACER FINS IN AN ISOTHERMAL SODIUM FLOW. Baumgaertner, E.; Borgstedt, H. U.; Drechsler, G. (Kernforschungszentrum, Karlsruhe (West Germany)). Feb 1973. 50p. (KFK-1723). Dep. NTIS $4.50.

Work performed under United States–Euratom Fast Reactor Exchange Program.

A model of a fuel element bundle composed of rods with 6 helical fins as spacers was investigated in an isothermal sodium flow over 1900 hours at temperatures of 600°C and sodium velocities of 4.7 m/sec. The 61-rod cluster was installed in hexagonal shrouds of different widths. The behavior of the points of support of the fins and the corrosion effects on surfaces and welds were examined. (auth)

12071 (EURFNR-1086) HELIUM TURBINE DESIGN FOR A 1000 MWe GAS-COOLED FAST BREEDER REACTOR WITH CLOSED GAS TURBINE CYCLE. Savatteri, C. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Feb 1973. 33p. (EUR-4853; KFK-1760). Dep. NTIS (U. S. Sales Only) $3.75.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Progress in reactor technology allows the achievement of coolant outlet temperatures above 700°C in the case of gas-cooled fast breeder reactors. These high coolant temperatures can be utilized completely through direct connection with a gas turbine. This direct connection of the gas turbine with the reactor is feasible provided that the coolant employed is inert and not susceptible to activation. Helium satisfies this condition. It serves as the reactor coolant and at the same time as the working fluid of the gas turbine and does not cause contamination of the individual plant components, which is important for the operating safety of the plant. The preliminary design of a double-flooded helium turbine for a 1,000 MW(e) gas-cooled fast breeder reactor is discussed. Several parameters, such as hub ratio, exit angle of the turbine wheel, and inlet angle of the guide wheel, influence the designed size of the turbine and the centrifugal stress of the blading. (GE)

12072 (EURFNR-1088) PRELIMINARY ANALYSIS OF THE PREDISASSEMBLY PHASE OF THE UNPROTECTED OVERPOWER TRANSIENT ACCIDENT FOR SNR 300. Kastenberg, W. E.; Rumble, E. T. III. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Systemtechnik und Reaktorphysik). Mar 1973. 27p. (KFK-1782). Dep. NTIS (U. S. Sales Only) $3.50.

Work performed under United States–Euratom Fast Reactor Exchange Program.

A simplified model of the predisassembly phase for unprotected overpower transients in LMFBR's is presented. The model includes fuel movement and sodium expulsion as a result of the molten fuel-coolant thermal interaction in the channels. The SNR-300, a prototype/demonstration plant is analysed and the results compared to an earlier set of calculations using the SAS-VENUS computational models. The previous analysis neglects fuel movement. The results indicate that substantial reductions in the severity of the transient, as measured by molten fuel produced, the thermal energy generated, and the final temperatures, can be obtained when fuel movement is included. (auth)

12073 (WARD-OX-3045-1) OXIDE FUEL ELEMENT DEVELOPMENT. Quarterly Progress Report for Period Ending March 31, 1973. Boltax, A.; Saling, J. H. (Westinghouse Electric Corp., Madison, PA. Advanced Reactors Div.). May 1973. Contract AT(11-1)-3045. 90p. AT $5.45.

Information is presented on the following subjects: irradiation testing of stainless steel clad mixed oxide fuel pins in the EBR-2; post-irradiation examination of fuel pins; fabrication development of EBR-2 subassemblies; fuel pellet fabrication; and design, development, fabrication, and testing of LMFBR fuel assemblies. (JWR)

Research, Test, and Experimental Reactors

Refer also to abstracts 10929 and 11369.

12074 (HEDL-TME-73-27) ANALYSIS OF THE FTR/EMC NEUTRON SHIELDING EXPERIMENT. Boulette, E. T.; Marr, D. R.; Bunch, W. L. (Hanford Engineering Development Lab., Richland, Wash.). Mar 1973. Contract AT(45-1)-2170. 249p. AT $7.60.

The results of a three-dimensional, multigroup diffusion theory analysis of the Fast Test Reactor/Engineering Mockup Critical (FTR/EMC) shielding experiments are presented. The absolute measurements of five different reaction rates at about 300 locations in the EMC configuration are compared with calculations, and the resulting analytical-experimental agreement is discussed in terms of the FTR design. A description of how the calculations were made to minimize computer cost is also presented. (auth)

12075 (NAA-SR-6207) SNAP 8 REACTOR PRELIMINARY DESIGN SUMMARY. Rosenberg, H. (ed.) (Atomics International, Canoga Park, Calif.). 15 Jun 1961. Contract AT(11-1)-Gen-8. 43p. Dep. NTIS $4.25.

Declassified 24 May 1973.

The present concept of the SNAP 8 reactor, reactor control system, safety systems, and shield are described and the reasoning behind the design point selection is explained. The power conversion system is covered briefly. (auth)

12076 (NP-19670) ANNUAL REPORT, 1971–1972. (Interuniversitair Reactor Instituut, Delft (Netherlands)). 1972. 89p. (In Dutch). Dep. NTIS (U. S. Sales Only).

The studies of the Interuniversitair Reactor Instituut at Delft for the year 1971–1972 are summarized. In neutron physics diffraction on gaseous argon; diffraction on liquid argon; self-diffusion in liquids; inelastic neutron scattering on argon; diffraction on molecular liquids; inelastic scattering of subthermal neutrons on cyclohexanol, neopentane, and methanol; and magnetic studies with polarized neutrons were reported. The Moessbauer effect was studied in α-FeOOH and α-Fe_2O_3 microcrystals, ferrites and garnets, organo-tin compounds, and intermetallic compounds. A new neutron spectrometer, Moessbauer spectrometer, and cold neutron source were developed. In reactor physics thermal neutron spectrometry, the reactor oscillator experiment, Doppler experiments in the Athene reactor, subcritical assemblies, a neutron generator, neutron capture measurements, Monte Carlo studies, material damage, and the PDP-9 computer system were discussed. In chemistry studies were reported in radiation chemistry, waste materials, radiochemistry, radiochemical analysis methods, activation analysis, utilization of radioisotopes, nuclear biotechniques, and the water purification project. In radiation hygiene and radiation dosimetry studies were reported on aerosol investigation, utilization properties of thermoluminescent detectors, and population doses as a result of radiodiagnostics. The education and training courses given in physics, reactor physics, chemistry, and radiation shielding and dosimetry are discussed. The professional and industrial efforts are summarized. The publications of the Institute are tabulated. (9 figures, 4 photographs, 4 tables) (JSR)

12077 (ORNL-TM-4121) THERMAL STRESS ANALYSIS AND LIFE PREDICTION OF MSRE FREEZE FLANGES. Gabbard, C. H. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 43p. Dep. NTIS $4.25.

Freeze flanges were included in the fuel and coolant piping systems of the Molten-Salt Reactor Experiment to provide the capability of remote removal and replacement of major components within the reactor cell. These freeze flanges were subjected to high cyclic thermal stresses during the various reactor operations because of their high thermal inertia and because of the high radial thermal gradient inherent in the design. The suitability of the freeze flange design was ensured both by a comprehensive thermal stress analysis covering all phases of the reactor operation and by thermal-cycle testing a full scale prototype flange assembly. The thermal stress analysis indicated high thermal stresses in the flange bore, but the life prediction by low-cycle fatigue analysis showed that the life would be adequate for the intended service. The prototype flange assembly was still serviceable when testing was discontinued after 540 cycles in the Thermal Cycle Facility. However, cracking and porosity were observed in

the flange bore during the dye-penetrant inspection following 268 thermal cycles. The surface porosity type failure had been predicted at 300 cycles by the thermal stress analysis. The 540 thermal cycles of the prototype flange assembly without mechanical failure or leakage would permit the calculated allowable life of the MSRE flanges to be increased by a factor of 1.95. The MSRE flanges completed up to 26,100 hours of high temperature salt exposure without indication of failure. (auth)

12078 (ORNL-TM-4183) POSTIRRADIATION EXAMINATION AND TESTING OF THE ORR N_F TRAY. Farrell, K.; Long, E. L. Jr.; King, R. T.; Jostsons, A. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 84p. Dep. NTIS $6.25.

An Oak Ridge Research Reactor (ORR) core lattice component, the N_F tray, became permanently bowed during reactor service. This tray, which was fabricated from recrystallized 1100 aluminum, reached maximum neutron fluences of about 3.0×10^{22} neutrons/cm^2 (thermal) and 3.2×10^{22} neutrons/cm^2 ($E > 0.1$ MeV) at an operating temperature of 40 to 50°C. Microstructural examination of the tray revealed voids, many dislocations and a fine precipitate of transmutation-produced silicon. These defects markedly increased the hardness and strength of the 1100 aluminum and also caused a significant loss of ductility. At test temperatures above 100°C ductility was further degenerated by helium embrittlement that resulted in premature intergranular fracture. The voids made the tray swell by about 1.5% at its center. This swelling was unequal on opposite sides of the tray and thereby resulted in bowing. The degree of bowing was calculated accurately from the swelling data. It is recommended that bowing can be minimized by intermittent annealing at 300 to 350°C whenever the first signs of bowing appear, or, better still, by fabricating the N_F tray from 6061 aluminum alloy in the precipitation-hardened T6 condition. (auth)

12079 (ORNL-TM-4244) CALCULATED KINETICS PARAMETERS FOR THE SOUTHWESTERN EXPERIMENTAL FAST OXIDE REACTOR ASSEMBLIES I-P, II-A, AND II-C. Rhoades, W. A. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 21p. Dep. NTIS $4.00.

The effective delayed neutron table detailing the production of neutrons in each delay group from each fissile nuclide is calculated, together with the prompt neutron generation time. Three SEFOR assemblies are considered, and a reference assembly is calculated using both P_0S_2 and P_3S_8 transport calculations. The generation time is sensitive to the reflector position, as is the delayed neutron contribution of ^{238}U. The ^{239}Pu contribution was essentially invariant. The ^{235}U and ^{240}Pu contributions show some variation, but their contributions are so small that their variations are not important. A comparison with experimental data shows fair agreement. (auth)

12080 (RT/ING-(72)5) ANOMALY OF THE TRIGA RC-1 REACTOR DURING THE EXECUTION OF NUCLEAR TESTS AT 1 MW. Di Palo, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 11 Nov 1972. 13p. (CONF-700867-1). Dep. NTIS (U. S. Sales Only) $3.00.

From European TRIGA owners' conference; Otaniemi, Finland (25 Aug 1970).

A fission product release accident occurred during the testing of the RC-1 reactor at 1 MW. It proved the high reliability of the continuous air monitor set up at the air suction system of the reactor building. A brief description of the instrument and an account of the accident are presented. Scheduled checks carried out to single out the failed fuel element and to ascertain the faults source are also added. (auth)

12081 (SLA-73-5153) NONDESTRUCTIVE TESTING OF PULSED REACTOR FUELS. Horak, J. A.; Karnowsky, M. M.; Sasmor, D. J. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 2p. (CONF-730611-6). Dep. NTIS $3.00.

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973).

Appropriate NDT methods for preirradiation characterization of fuel plates for the SPR-II were evaluated after the failure of a fuel plate and two control rods. The NDT methods utilized were dye penetrant, ultrasonic reflection, x-ray radiography, immersion density and optical metallography. Best results combined with ease and/or simplicity are obtained from the ultrasonic reflection and the immersion density methods. (FS)

12082 (STI/PUB-316) IRRADIATION FACILITIES FOR RESEARCH REACTORS. Proceedings Series. Proceedings of the Symposium Held in Teheran, Iran, November 6-10, 1972. (International Atomic Energy Agency, Vienna (Austria)). Feb 1973. 487p. (In French and English). (CONF-721138-). IAEA $17.00.

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972).

Information on research reactor irradiation facilities is presented under the following headings: rigs and capsules for research and engineering; tailoring of radiation fields; cold neutron sources and cryogenic systems; research programs and facilities; specialized applications; and transfer systems. Separate abstracts are included for 25 of 33 papers presented. Eight papers previously abstracted and included in NSA may be located under CONF-721138 in the Report Number Index. (DCC)

For abstracts of individual papers see: 12084-12108.

12083 (SURRC-47/73) FUEL PLATE TEMPERATURES FOLLOWING SHUTDOWN OF THE SCOTTISH UNIVERSITIES RESEARCH AND REACTOR CENTRE REACTOR: THEORETICAL AND EXPERIMENTAL RESULTS. Riley, J. A.; Donald, S. R. (Scottish Research Reactor Centre, East Kilbride (Scotland)). 1972. 44p. Dep. NTIS (U.S. Sales Only) $4.25.

Experimental and theoretical work carried out at the Scottish Universities Research and Reactor Centre into the problem of reactor shutdown fuel plate temperature variation is described. A mathematical model was developed that predicts the fuel plate temperature behavior of the Scottish Universities Research Reactor following a "scram" shutdown in which the core water is "dumped" immediately on shutdown. This model predicts the maximum fuel plate temperature variation with time after shutdown from a given set of steady state reactor operating conditions. The "model" fuel plate temperature predictions compare well with the comparable experimentally determined values within the present reactor power range of up to 300 kW. Further the mathematical model was used to predict reactor fuel plate temperature behavior outside the present reactor operational range. The predicted variation of T_{fm} with reactor power for a constant reactor operation period of six hours and a reactor power range of up to 500 kW is shown. For a constant reactor power of 300 kW, the predicted variation of T_{fm} with the time after reactor shutdown, t, for reactor operation periods of up to 96 hours is presented. In order to make these predictions it was necessary to use in the model empirical relationships that were developed from experimental results obtained from the reactor working within its present operational range. The use of these empirical relationships is discussed. (auth)

12084 DESIGN OF IRRADIATION EXPERIMENTS FOR MATERIALS TESTING REACTORS. McAneny, R. S. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). pp 3-24 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

An approach to the design of in-pile assemblies and the fundamental problems facing designers of these assemblies are discussed. The irradiation rig program at the Australian Atomic Energy Commission is discussed and some general purpose rigs used at Lucas Heights are described. (3 references) (auth)

12085 SOME SPECIAL FEATURES OF IRRADIATION AND BEAM-HOLE EXPERIMENTS AT THE NEW REACTOR BER II OF THE HAHN MEITNER INSTITUE FOR NUCLEAR RESEARCH. Buchholz, H.; Fischer, C. O.; Wasserroth, K. F. (Hahn-Meitner Inst. for Nuclear Research, Berlin). pp 25-38 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

In the Hahn-Meitner Institute for Nuclear Research a new swimming-pool reactor with a power level of 5 MW and the possibility of neutron pulse operation is at present under construction and will come into operation early in 1973. Some of the characteristic data and the new design features are presented. The irradiation and beam-tube facilities at this new reactor have been designed under consideration of the special requirements of the scientific program of the Hahn-Meitner Institute, in particular with respect to the significant aim of low inelastic neutron scattering in condensed matter. Facilities for various irradiation conditions are described: short and long irradiation times, different neutron fluxes and spectra. Slow neutron beam facilities with a chopper and a mechanical selector in connection with cooled moderators and filters have been designed with special regard to optimum intensity to background ratios in an extended neutron energy range. The results of test experiments at the reactor BER I are described. (16 references) (auth)

12086 SPECIAL IRRADIATION FACILITIES AT THE UNIVERSITY OF MISSOURI RESEARCH REACTOR FACILITY. Cox, E. L.; Parkinson, T. F. (Univ. of Missouri, Columbia). pp 39-58 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

The University of Missouri Research Reactor Facility (MURR) located in Columbia, Missouri, is a 10-MW flux trap reactor capable of thermal neutron flux levels up to 7.0×10^{14} n · cm^{-2} · s^{-1}. The reactor is currently operating at a power level of 5 MW and is expected to reach design power in January 1973. Initially the useful volume of the flux trap was a cylindrical tube of 868 cm^3 volume. Recent design modifications have increased the volume by a factor of 3 with a loss of only 5% in average neutron flux. Since the reactor has only 6 beam ports, it is desirable to get maximum utilization from each port. One beam port uses a specially designed collimator providing two beams to a double-axis and to a triple-axis neutron diffractometer. Apparatus at another beam port utilizes a Fermi chopper for time-of-flight spectrometry while also employing a Fourier chopper on the residual beam for additional investigation. This beam port also employs a special collimator containing a liquid nitrogen-cooled beryllium filter. A third beam port is used for a neutron decay spectrometer. An aluminium insert in the reactor's beryllium reflector enhances the fast neutron spectrum. The instrument is used to measure total cross-sections in the energy range 10 keV to 1 MeV. The large graphite thermal column of the reactor has been converted to a neutron radiography facility by installing a divergent collimator. The design allows the insertion of several apertures resulting in L/D ratios of 20 to 400. A monoenergetic gamma-ray beam is provided at one beam port by inserting source materials in a modified beam tube at the outer circumference of the reactor beryllium reflector. This capture gamma beam is used for various nuclear physics experiments including gamma-induced fission cross-section measurements. Space for large volume irradiations is available in the graphite reflector and in the bulk pool. Special irradiation facilities have been developed for these regions, including a controlled temperature container utilizing a helium gas annulus and a container designed to maximize the thermal neutron-to-gamma ratio. (9 references) (auth)

12087 DESIGN AND EXPERIENCE WITH RIGS SIMULATING LWR CONDITIONS IN A RESEARCH REACTOR. Hagen, H.; Hansen, K.; Leth, J. A. (Danish Atomic Energy Commission, Roskilde). pp 79-88 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

The design, development, and operating experience with high-pressure rigs for Light Water Reactor (LWR) fuel testing under simulated power reactor conditions in the Danish research reactor DR 3 are described. In the rigs the fuel pins are cooled by natural convection in pressurized water with heat loads up to 950 W/cm. The rigs are connected to an out-of-pile control circuit by means of which the water quality, the system pressure and the fission gas release are controlled and regulated. Over the last four years the rigs, which are very cheap to manufacture and operate, have been used extensively for a wide range of experiments with both pelletized and Vipac fuel. The experiments include tests to evaluate the influence of, for example, high burnup, power cycling, shuffling and high heat loads on fuel pins of different designs. 3 references. (auth)

12088 IRRADIATION INSTALLATIONS FOR FISSION GAS ANALYSIS OF FUEL ELEMENTS. Stechemesser, H.; Bachner, E.; Euringer, H.; Meixner, Ch.; Schmidt, F.; Zeumann, J. (Kernforschungsanlage, Juelich, Ger.). pp 89-104 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

To detect the release to birth rate of fission gases the capsules are swept by gas during irradiation. This can be done by either open gas systems or closed gas circuits. In Juelich emphasis has been laid on the development of closed circuits with extreme gas purification on-line and sweeping the irradiation capsules in bypass. An irradiation facility with 10 swept irradiation capsules and gas sampling in a hand-operated glove box has been installed at the reactor DIDO in Juelich. The multicapsule rigs used are temperature-controlled by a gas mixture. Another sweep circuit system for six swept irradiation capsules has been installed at the R2 reactor in Studsvik, Sweden. This irradiation facility was extended for the reactor BR2 in Mol, Belgium. Two multicapsule rigs are in operation. The temperature control of the rigs is done by a gas mixture with a special closed helium-neon circuit. The irradiation capsules are swept by 6 separate sweep-gas circuits, which are connected on-line to an automatic fission gas analyzing equipment. This analyzing equipment is operated by a process computer. 9 references. (auth)

12089 RESONANCE WINDOW FILTERS OF NEUTRON FOR RESEARCH AND DEVELOPMENT. Brugger, R. M.; Simpson, O. D. (Aerojet Nuclear Co., Idaho Falls, ID). pp 131-160 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

High intensity beams of 2, 24.5 and 144-keV neutrons have been developed and their usefulness and advantages have been demonstrated at the National Reactor Testing Station in Idaho. These beams were produced by filtering the gross beam from the Materials Testing Reactor (MTR) through scandium, iron and silicon. The filtering phenomenon of these materials depends on the interference dips in their neutron total cross-section acting as windows for an energy band pass of neutrons. Such interference dips occur in certain isotopes because of the destructive interference between S wave resonances and the potential scattering. Fluxes of 5×10^6, 6×10^5 and $\sim 10^7$ n · cm^{-2} · s^{-1}, respectively, were obtained, even though the filters were not optimized for intensity. These filters not only remove most of the neutrons other than the band pass energy but also drastically suppress the gamma flux. Development work at the MTR has determined adequate lengths, identified ways to further suppress backgrounds of unwanted neutrons and gammas, identified the energy and width of the flux passed by the filters and demonstrated a number of applications. The most successful way of suppressing the background of higher energy neutrons was found to be to add relatively small amounts of other materials that have low cross-sections at the primary window of the filter but higher cross-sections at the higher energy windows. For the iron filter this turned out to be blocks of sulphur and aluminum. For scandium it has been identified that the addition of ^{54}Fe and possibly ^{57}Fe may satisfactorily suppress the higher energy neutrons. A sufficient amount of these isotopes is available at the Oak Ridge National Laboratory. These filtered beams can represent a set of standard reproducible neutron fluxes in the intermediate energy range. They can be used for cross-section standards, neutron flux standards, gamma production studies, nuclear structure studies, shielding penetration studies, biological and agricultural irradiation studies, and as a prompt activation analysis facility. These filters are now being installed at intermediate flux reactors, and are finding applications for research at accelerators. 24 references. (auth)

12090 FISSION NEUTRON SOURCE AT THE TRIGA MARK II REACTOR IN LJUBLJANA. Najzer, N.; Rant, J. (Josef Stefan Inst. of Nuclear Science). pp 161-164 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

A thermal to fast neutron converter plate (260 mm diam., 1.5 mm thick) made of 20% enriched uranium was used for the fission neutron source. The plate was clad with 0.8 mm of aluminum to prevent the release of fission products. The source was installed in the exposure room reconstructed from the bulk shielding facility pool of TRIGA Mark II reactor. In the working position the source was located in front of the thermalizing column at a distance of 110 cm. When not in use it was stored in a cask made in the floor of the exposure room. The source was manipulated by telecommand from the outside of the room, while an interlock system prevented entry into the room when the source was in the working position. The original thermalizing column configuration was modified to obtain optimum source performance regardless of the source intensity and the fast neutron background from the reactor core. At present the fast neutron flux at the converter surface is 4.2×10^7 n · cm^{-2} · s^{-1} at full reactor power of 250 kW. This rather low intensity is due to a large source to room wall distance, which on the other hand ensures negligible fission spectrum distortions due to fast neutron scattering in the surrounding walls. The source was used for the determination of fission spectrum averaged activation cross-sections of some threshold detectors and for fast neutron irradiations during investigations of mutations in barley seeds. 3 references. (auth)

12091 METHOD FOR OBTAINING A LARGE-AREA BEAM FROM A REACTOR BEAM TUBE FOR USE IN NEUTRON RADIOGRAPHY. Kedem, D. (Soreq Nuclear Research Centre, Yavne, Israel). pp 165-172 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

Neutron radiography has in recent years become a very important method of non-destructive testing in industry and research.

The resolution of the radiographs obtained is an important parameter and is determined by several factors: beam divergence; converter thickness; distance between the object and the converter; distance between the converter and the film; and grain size of the film. Gadolinium deposited on an aluminium foil is the most frequently used converter. Enrichment with ^{157}Gd allows a thinner coating and influences the resolution. The beam divergence is measured by the parameter D/L (inverse of the collimation ratio L/D) and about 10^9 n/cm^2 are needed for a radiograph. At the Soreq Nuclear Research Centre a beam tube of the swimming-pool type reactor has been adapted for neutron radiography. The entrance silt for thermal neutrons has not been chosen close to the core but set at 80 cm from the object to provide a larger radiograph area, while keeping the resolution constant. The device is described in detail. 6 references. (auth)

12092 DEVELOPMENT OF CAPTURE GAMMA RADIOGRAPHY WITH A RESEARCH REACTOR. Palmgren, A.; Reijonen, H.; Leikkonen, I. (Technical Research Center of Finland). pp 173-184 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

In the radiography of steel thicknesses above about 150 mm various accelerator sources are usually used, whose disadvantages are high purchase and operating costs. The capture radiation that can be obtained from a research reactor offers a new possibility of radiographing heavy components with a hard gamma radiation beam at a rather low expense. An intense gamma beam is obtained from the reactor by increasing the original gamma radiation of the reactor by a capture gamma target, which is placed in a high neutron flux. Chlorine, titanium, manganese and cadmium were evaluated as possible target materials and it was found that Cd had the best properties. Capture-gamma targets made of Cd were placed in the tangential and radial beam tubes of a 250-kW TRIGA Mk II research reactor. The target in the tangential beam was cylindrical, 3 cm in diam. and 60 cm in length, placed in the middle of the beam tube adjacent to the reactor core. In the beam tube were lead collimators and filters of borated paraffin to eliminate neutron and soft gamma radiation from the beam. Geometric considerations necessitated a distance of 5.5 m between the source and the radiographical image plane, where the dose rate was 180 R/h. Similar arrangements were made in the radial beam tube but the radiation output was much smaller because it was not possible to place a sufficiently large target close to the reactor core. The penetration of the capture-gamma beams was comparable to that obtained by a 7-MeV linear accelerator or betatron, although the exposure times were considerably greater. The maximum thickness of steel that could be radiographed was about 300 mm and the maximum resolution was 0.35%, as measured by a wire indicator. This method has been used in the radiographic inspection of heavy components (150–300 mm of steel) and it was found that the cost per radiograph is very competitive. 9 references. (auth)

12093 NISUS: A NEUTRON INTERMEDIATE STANDARD URANIUM SOURCE. Azad, S. (Imperial Coll. of Science and Tech., London); Besant, C. B.; Emmett, J.; Rickard, I. C.; Campbell, C. G.; Jones, T. C.; Kerridge, M.; Peter, J.; Williams, J. pp 185-201 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

The standardization of measuring techniques between different laboratories in fast reactor physics has not been easy because of the lack of any standard neutron source that could fulfill the requirements of fast reactor physics. Some limited technique intercomparison work has been achieved by building identical special cores, in fast reactors such as ZEBRA, in two different laboratories. This is an expensive method of obtaining a standard and is limited to a very few laboratories in about six countries. The creation of a fast neutron standard that would be inexpensive and that could be adopted by a large number of laboratories as an international standard is described. As a result of collaboration between CEN/SCK Belgium, UKAEA and Imperial College, a facility was designed and built at Imperial College with the above aims in mind. The detailed requirements for a standard and the construction and initial use of the facility at Imperial College are discussed. 10 references. (auth)

12094 NEUTRON ABSORBER TECHNIQUES DEVELOPED IN THE STUDSVIK R2 REACTOR. Sandklef, S.; Bodh, R. (AB Atomenergi, Studsvik, Sweden). pp 213-231 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

Specifications for irradiation tests in the Studsvik R2 reactor have increased in complexity and necessitated the development of new techniques to control the neutron flux. Absorbing materials are used in various newly developed ways to cover the following requirements: axial thermal flux flattening; achieving specified thermal fluxes; regulating thermal flux on a short time scale; and changing the thermal to fast flux ratio. The results described are generally applicable in materials testing reactors, both for LWR fuel testing and for isotope production and other irradiations where control of thermal flux is desired. Some of the test facilities in the R2 reactor are listed with reference to the type of neutron absorbers used. The background of the developmental work is also given. Solid-state absorbers can be used to flatten and depress the thermal neutron flux density in a rig for longer periods. Some applications with silver and hafnium absorbers are presented. The attenuation properties have been experimentally determined and theoretical calculations have been carried out showing very good agreement between experiment and theory. Testing of LWR fuel under transient power conditions requires the continuous regulation of thermal neutron flux density. For this purpose ^3He gas was chosen. The variation of neutron absorption is achieved by regulating the ^3He pressure in a coil surrounding the sample. Experimental results and theoretical calculations are given. ^{10}B and ^6Li in H_3BO_3 and LiOH solutions are discussed. 4 references. (auth)

12095 ENGINEERING ASPECTS OF THE COLD NEUTRON SOURCE AT THE REACTOR DIDO. Doose, C.; Stelzer, F.; Stiller, H.; Tholen, A. (Kernforschungsanlage, Juelich, Ger.). pp 235-246 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

The development and behavior are described of the cold neutron source and in particular the in-pile reactor section and the out-of-pile arrangements for the low-temperature supply. 9 references. (auth)

12096 COLD NEUTRON SOURCE ON A 5-MW POOL REACTOR. Todd, M. C. J. (Atomic Weapons Research Establishment, Harwell, Eng.). pp 261-269 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

Two designs of a cold neutron source, filled with a liquid hydrogen-deuterium mixture, have been operated on the HERALD reactor in the United Kingdom. The reactor is a light water moderated pool reactor that is normally operated at 5 MW. To allow the installation of the source, space was provided by removing the center section of one of the two tangential beam tubes. After cutting the beam tube, end caps were welded over the open ends so that the source chamber could be suspended within the reactor tank and located between the two end caps. This arrangement has the advantage that cold neutrons are fed to two beam tubes, but has the disadvantage that the end caps attenuate the neutron current. A hydrogen refrigerator is used to cool the source chamber and was chosen on the grounds of economy. The source and refrigerator systems are separate so that the mixture of hydrogen and deuterium in the source can be varied. The choice of a hydrogen refrigerator has allowed a compact heat exchanger to be designed that is located above the source chamber so that heat is removed by natural convection circulation of the hydrogen-deuterium mixture. The hydrogen refrigerator is located outside the reactor hall and is connected to the heat exchanger by a long transfer line. The volume of the source chamber was limited by the space available in the vicinity of the beam tubes. The first chamber had a volume of 5 liters and the second 3 liters. By varying the hydrogen-deuterium mixture it has been shown that the cold neutron current passes through a maximum. The variation has not, however, been as great as expected and it is now considered that a small hydrogen-filled source placed as close as possible to the reactor core would provide higher cold neutron currents. With the present 3-liter source the current of thermal neutrons into the source was made as large as possible by surrounding the source chamber by a reflector tank filled with heavy water, and by placing two beryllium filter sections in the source chamber in line with the beam tubes. 2 references. (auth)

12097 DESIGN AND MANUFACTURE OF A COLD-NEUTRON SOURCE FOR THE DANISH RESEARCH REACTOR DR 3. Hagen, H.; Leth, J. A. (Danish Atomic Energy Commission, Roskilde). pp 271-279 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

The design, development and manufacturing of a cold-neutron source are described. The cold-neutron source for DR 3 is based on supercritical hydrogen at about 25°K as the moderator. This makes it possible to adjust the hydrogen density in the moderator

chamber by small changes in the gas temperature. The necessary cooling capacity is supplied by two Philips Stirling B20 cryogenerators. The hydrogen is circulated between these cryogenerators and the in-pile moderator chamber by small fans. The safety of the facility is based on the use of triple containment preventing contact between hydrogen and air. The triple containment is achieved by enclosing the high vacuum system, surrounding the hydrogen system, in a helium blanket. 4 references. (auth)

12098 SIMPLE CRYOGENIC FACILITIES FOR CHEMICAL EXPERIMENTS WITH WATER-COOLED NUCLEAR REACTORS. Rowland, F. S.; Miller, G. E.; Grant, P.; Steinkruger, F. J. (Univ. of California, Irvine). pp 281-290 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

In many experiments the availability of a cryogenic facility is of critical importance. Materials that are normally gases can be irradiated as liquids or solids in liquid-nitrogen cooled capillaries. The chemical behavior of atoms in crystalline solids is usually quite different from that in fluid systems and important kinetic information can thus be obtained. Liquid nitrogen temperatures can be held for about ten minutes with a specially-built small vacuum-jacketed flask, and this is sufficient for short-lived radioactivities such as ^{38}Cl. The determination by ^{38}Cl neutron activation analysis of organically-bound chlorine in aqueous samples can be carried out in the presence of inorganic chloride through irradiation of frozen samples at −196°C; the determination is unsuccessful for identical samples irradiated as aqueous solutions. Data are given about flux reproducibility and other reactor characteristics for such experiments. Longer irradiations can be carried out in a neutron irradiation facility cooled by slowly flowing liquid nitrogen. The positive pressure of continued nitrogen flow avoids possible condensation of liquid oxygen. The facility is compatible with the normal fuel-loading arrangements in a TRIGA reactor, and has an interior irradiation space 0.95 cm in diameter. The design and operational characteristics of this facility are discussed in detail. 5 references. (auth)

12099 FACILITIES FOR NEUTRON IRRADIATION AND RESEARCH AT TROMBAY. Iyengar, P. K. (Bhabha Atomic Research Centre, Trombay, India). pp 307-323 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

Two pneumatic facilities for capsule irradiation at flux levels of 10^9 and 5×10^{13} n · cm^{-2} · s^{-1}, respectively, an irradiation rig for resistivity measurements and a pressurized water loop for engineering experiments are described. Spectrometers used for obtaining polarized and unpolarized neutron beams in the energy range from 5 to 120 MeV and a filter arrangement for obtaining 25-keV monochromatic neutron beam are also described. 10 references. (auth)

12100 EXPERIMENTAL AND IRRADIATION FACILITIES AT THE BANDUNG REACTOR CENTRE. Linggoatmodjo, K.; Subki, I. R. (Bandung Reactor Centre, Indonesia). pp 325-329 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

Several facilities for radioisotope production and sample irradiation are available at the TRIGA 1000-kW reactor at the Bandung Reactor Centre. They include the following typical facilities: rotary specimen rack (lazy Susan); pneumatics transfer system; the central thimble, bulk shielding tank and the standard TRIGA irradiation facility in the thermal column. A detailed description of the activities and utilization of these facilities is given. A short account is also given of the program in the near future of the construction of a neutron radiography facility and more in-pile irradiation facilities for fast, thermal neutron and gamma irradiation of biological samples. 3 references. (auth)

12101 IRRADIATION FACILITIES IN AND AROUND THE TR-1 REACTOR CORE. Oener, Oe. D. (Çekmece Nuclear Research and Training Center, Istanbul). pp 331-347 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

Two sample guide tubes, two dry tubes, one irradiation rig, one graphite reflector element and one control fuel element are in use in TR-1 core as irradiation facilities. Beside these and the stringers used for flux measurements, a fast flux irradiation facility, a sealed container and a milk-can facility are available if required. Experimental facilities built-in the reactor and the equipment mounted in and on these are presented. Emphasis has been placed on design and construction as well as utilization and experience. Dimensions and flux values may be considered specific for local users; however, comments on design experience and discussions related to core configurations may be of value to similar small-facility operators and users. 10 references. (auth)

12102 TRIGA RESEARCH REACTOR EXPERIMENTAL INSTRUMENTATION. Simnad, M. T.; Chesworth, R. H. (Gulf Energy and Environmental Systems, San Diego, CA). pp 349-374 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

Forty-three TRIGA research reactors have been placed in operation since the year 1958. A wide variety of experimental studies have been carried out in these reactors, many of which required the development of special instrumentation. A brief review of the design and operating experience associated with special instrumentation developed for experiments carried out in the TRIGA reactors is presented. The special characteristics and capabilities of the uranium-zirconium hydride fuel system are briefly described. 9 references. (auth)

12103 ZERO-ENERGY FAST REACTOR AT TROMBAY. Iyengar, P. K. (Bhabha Atomic Research Centre, Trombay, India). pp 375-382 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

The plutonium-fueled zero-energy fast reactor PURNIMA is described. The reactor comprises a 3-liter core surrounded by a thick reflector of copper and iron. The fuel is sintered PuO_2 pellets fabricated into rods. Control is achieved by varying the efficiency of neutron reflection into the core. PURNIMA is a mock-up of a repetitively pulsed fast reactor, which is proposed to be set up at the Reactor Centre near Madras. A brief review of the experiments being carried out at this facility is included. (auth)

12104 IRRADIATION FACILITIES AT THE TEHRAN UNIVERSITY RESEARCH REACTOR. Sarram, M.; Farivar-Sadri, N. (Tehran Univ. Nuclear Centre). pp 385-394 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

The Tehran University Research Reactor is a 5-MW pool type, light-water moderated, heterogeneous solid fuel reactor. Initial criticality was achieved in November 1967 and 5-MW operation was reached in January 1968. The reactor, being a typical research reactor, has the standard experimental and irradiation facilities such as beam tubes, thermal column, pneumatic rabbit system. In addition, the reactor has a dry gamma room and dry neutron irradiation chamber. The design features of these irradiation facilities are presented in detail. In addition, the installation of various experimental facilities which are under study are discussed. 2 references. (auth)

12105 EXPERIENCE WITH A BIOLOGICAL IRRADIATION FACILITY OPERATED AT A THERMAL REACTOR. Zarand, P.; Santha, A.; Mandi, E.; Varteresz, V.; Predmerszky, T.; Sztanyik, L. B. (Frederic Joliot-Curie National Research Inst., Budapest). pp 411-419 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

The most important problems of an irradiation facility operated at a thermal reactor are stability problems. A short description of the construction and dosimetry of the irradiation facility at the Central Research Institute for Physics is presented. The stability of this facility has been analyzed by means of biological indicators, theoretical calculations and physical measurements. The controls of biological experiments (30-day survival and decrease of spleen weight and iron incorporation) were used as indicators, along with activation techniques and TL dosimeters. Results were compared with theoretical calculations. It was found that the neutron spectrum and neutron to gamma ratio are practically unchanged in different reactor periods if the reflector thickness is not altered. The dose rate stability in a reactor period is better than 5%. A correlation was found between the reactor power, monitor reading, fast neutron flux and dose rate. 18 references. (auth)

12106 FAST NEUTRON AND GAMMA SEED IRRADIATION FACILITIES AT THE TRIGA MARK II REACTOR IN LJUBLJANA. Najzer, M.; Pavko, M. (Josef Stefan Inst. of Nuclear Science,

Ljubljana, Yugoslavia). pp 421-430 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

Two fast neutron and one gamma-irradiation facilities have been installed and calibrated. The fast neutron facilities were designed to obtain the maximum ratio of fast neutron to gamma and thermal neutron intensity. They were made of depleted uranium, which provided an excellent gamma and thermal neutron shield acting at the same time as a converter of thermal to fast neutrons. One fast neutron facility was located in the reactor pool between the core reflector and pool wall, while the other was installed in the central hole of the thermal column. Both facilities provided a net irradiation space of 100 cm^3 (40 mm diam. × 80 mm height) where irradiations uniform to within ±5% could be obtained. Three standard irradiation containers (16 mm diam. × 60 mm height) could be irradiated simultaneously. The gamma irradiation facility was made of cadmium, which converted thermal neutrons to gamma rays, and was located in the thermal column hole. The performance of the facilities was determined by measuring the profiles of fast neutron and gamma doses, fast and thermal neutron fluxes and temperature at the different positions of the facilities. Radiation doses were measured by a pair of ionization chambers, one gamma, the other gamma and fast neutron sensitive. Fast and thermal neutrons were detected by activation of indium and gold foils respectively. It was established that the requirements for seed irradiation were fulfilled over the whole operating range of all three facilities, and far exceeded over most of the operating range. On comparison the TIF was found to be superior with regard to irradiation conditions while the advantages of TCIF were its simple installation and manipulation of samples and lower price. For both facilities rather a strong influence of sample quantity on the fast neutron dose rate was established. 8 references. (auth)

12107 ULTRAFAST RABBIT SYSTEM AT THE TRIGA MARK III REACTOR OF GSF AT MUNICH. Kreiner, H. J. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Munich). pp 433-439 of Irradiation Facilities for Research Reactors. Vienna, International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

An ultrafast transfer system will be built up at the TRIGA-Reactor FRN. The system will work automatically and in synchronization with the reactor pulse. The time between the end of neutron irradiation and start of measurement will be less than 100 ms. This transfer system, which is connected to an automatic detector system (Ge/Li-detector, multi-channel analyzer and processing computer), can also be used for two special types of study: (a) basic investigations concerning the charge distribution of primary fission products; and (b) activation analysis of short-lived nuclides. The second application is performed in cooperation with the FRN activation analysis group. 7 references. (auth)

12108 FAST PNEUMATIC TUBE FOR NEUTRON ACTIVATION ANALYSIS UTILIZING SUB-SECOND ACTIVITIES. Guinn, V. P.; Miller, D. A.; Miller, G. E. (Univ. of California, Irvine). pp 441-448 of Irradiation Facilities for Research Reactors. Vienna; International Atomic Energy Agency (1973).

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972). See STI/PUB-316; CONF-721138-.

A fast pneumatic tube at the University of California at Irvine (UCI) is described. Except for the precision timers used in the system the total cost of this system was less than $1000. It is being used successfully in the UCI TRIGA reactor, with or without a cadmium annulus as desired. The system is described in detail. Its main components are solenoid valves, a cylinder of compressed nitrogen, buffer tanks, load and return photocells, reactor and counter sample termini, polyethylene and aluminium tubing and precision timers. The sample container-rabbits are machined polyethylene containers of about 1 cm^3 volume. The transit-time reproducibility of the system is very good. For example, at a nitrogen pressure of 70 $lb/in.^2$ gauge the rabbit travels the 70 ft from the reactor core into the Ge(Li) or NaI(Tl) gamma-ray spectrometer counting position in 0.423 ± 0.008 s. Good results have been obtained using this system for the NAA detection and measurement of lead via the 0.80-s ^{207m}Pb activity—both with steady reactor thermal-neutron fluxes of $\sim 10^{12}$ n · cm^{-2} · s^{-1} and with ~1000 MW reactor pulses (giving a peak thermal-neutron flux of $\sim 10^{16}$ n · cm^{-2} · s^{-1}). 3 references. (auth)

12109 THERMAL ANALYSIS OF THE PENNSYLVANIA STATE UNIVERSITY BREAZEALE NUCLEAR REACTOR. Haag, J. A. (Knolls Atomic Lab., Schenectady, NY); Levine, S. H. Nucl. Technol.; 19: No. 1, 6-15(Jul 1973).

An experimental and analytical program has been performed to study the temperature distribution, as a function of reactor power, in the TRIGA reactor at the Pennsylvania State University. A two-dimensional digital computer program written in FORTRAN language numerically solves Poisson's heat equation using finite difference techniques. Experimental measurements of the fuel temperature in the core midplane and in the water over a large portion of the core are incorporated into the computer code, which permits determining the temperature distribution through the core as a function of power. Several interesting results were obtained, one of which showed that subcooled boiling commences in the core between 150 and 200 kW. (auth)

Production and Materials Testing and Processing Reactors

12110 (DP-1305) SOURCE ROD FAILURE AND SUBSEQUENT DECONTAMINATION. Longtin, F. B. (Du Pont De Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Apr 1973. Contract AT(07-2)-1. 72p. Dep. NTIS $5.45.

On November 9, 1970, an antimony-beryllium source rod failed while suspended in air on the charge machine over the Savannah River Plant K Reactor. This failure released 80,000 curies of radioactivity into the Reactor Process Room, and an additional 39,000 curies remaining in the failed rod was deposited in the Disassembly Basin before the nature of the failure was recognized. Very little of this radioactivity was released outside the reactor building. The atmospheric release was about 0.003 Ci, and liquid releases were about 7.4 Ci to the K containment basin and 0.52 Ci to a plant stream. None of the activity has been detected outside the plant perimeter fence. Nearly all of the 80,000 Ci released to the Process Room remained adhering to or lying on the charge machine, and was by far the major source of radiation preventing personnel entry into the Process Room. It was removed by remote vacuuming and by manually removing parts of the machine with extension tools while the machine remained in the Process Room. The removed parts and debris were temporarily stored underwater in the Disassembly Basin. Remote vacuuming of the reactor top surface and floor by equipment carried on the discharge machine reduced radioactive contamination of those surfaces only slightly. Manual cleaning with wire brushes, vacuum cleaners, and chemicals was necessary to reduce radiation to levels at which normal reactor operation can be resumed. Clean-up of the radioactive contamination took 3 months with the participation of 850 people, none of whom received excessive radiation exposure. (auth)

Propulsion and Package Reactors

Refer also to abstracts 11208, 12145, and 12168.

12111 (N-72-24686) LONG-LIFE, SPACE-MAINTAINABLE, NUCLEAR STAGE REGULATORS AND SHUTOFF VALVES. Final Report. (Aerojet Nuclear Systems Co., Azusa, Calif. (USA)). Mar 1972. Contract NAS8-27568. 236p. (NASA-CR-123568; RN-A-71007). NTIS.

The six most promising valve, regulator, and remote coupling concepts, representing the more radical designs from twenty concepts generated, were investigated. Of the three valves, one has no moving parts because shutoff sealing is accomplished by an electromagnetic field which ionized the flowing fluid. Another valve uses liquid metal to obtain sealing. In the third valve, high sealing forces are generated by heating and expanding trapped hydrogen. The pressure regulator is an electronically controlled, electromechanically operated, single state valve. Its complexity is in electronic circuitry, and the design results in less weight, increased reliability and performance flexibility, and multipurpose application. The two remote couplings feature the minimization of weight and mechanical complexity. One concept uses a low melting temperature metal alloy which is injected into the joint cavity; upon solidification, the alloy provides a seal and a structural joint. The second concept is based on the differential thermal expansion of the coupling mating parts. At thermal equilibrium there is a predetermined interference between the parts, and sealing is achieved by interference loading. (auth)

12112 (NAA-SR-6293) PROGRESS REPORT SNAP 8 REACTOR DEVELOPMENT, DECEMBER 1960–MARCH 1961. Johnson, C. E. (Atomics International, Canoga Park, Calif.). 15 Aug 1961. Contract AT(11-1)-Gen-8. 42p. Dep. NTIS $4.25.

Declassified 24 May 1973.

Progress is reported on project objectives, major accomplishments to date, progress, and evaluation of effort. Work conducted under SNAP 8 includes: control analysis and development, fuel

development, core analysis, heat transfer development, and design of the S8ER (SNAP 8 Experimental Reactor). (auth)

12113 (NAA-SR-6735(Add.1)) PRELIMINARY DESIGN OF A 150 KW SNAP REACTOR. (Atomics International, Canoga Park, Calif.). 15 May 1962. Contract AT(11-1)-GEN-8. 39p. Dep. NTIS $4.00.

Declassified 17 Apr 1973.

Three concepts based on SNAP 8 for its use as a high-power space electrical generating system incorporating mercury-vapor zirconium hydride technology are briefly described and compared. The first concept consists of four secondary loops incorporating SNAP 8 hardware. The second incorporates two secondary loops, each with a single turbine driving a SNAP 8 alternator. The third concept includes a single secondary loop with sealed components. (FS)

12114 (NAA-SR-6791) SNAP 2 NUCLEAR AUXILIARY POWER UNIT DEVELOPMENT. Progress Report, July–September 1961. Shackelford, M. (ed.). (Atomics International, Canoga Park, Calif.). 1 Feb 1962. Contract AT(11-1)-Gen-8. 74p. Dep. NTIS $5.75.

Declassified 24 May 1973.

Progress is reported on SNAP-2 Flight System Configuration, System Analysis, Instrumentation, Component Development, Non-nuclear System, and Operation Analysis. Effort was directed toward the completion of the overall SNAP 2 system design and analysis. Mechanical arrangement and structural support of all major system components were established. The fabrication of the first copper-clad steel honeycomb radiator-condenser was completed. Major components of the first non-nuclear thermal system test, PSM-1, were delivered to the test site. (auth)

12115 (NAA-SR-6792) PROGRESS REPORT FOR SNAP 8 REACTOR DEVELOPMENT, JULY–SEPTEMBER 1961. (Atomics International, Canoga Park, Calif.). 15 May 1962. Contract AT(11-1)-Gen-8. 118p. Dep. NTIS $8.00.

Declassified 18 Jun 1973.

12116 (NAA-SR–6794) PROGRESS REPORT SNAP 2/10 REACTOR, JULY–SEPTEMBER 1961. Haussler, W. M. (ed.). (Atomics International, Canoga Park, Calif.). 15 Feb 1962. Contract AT(11-1)-Gen-8. 56p. Dep. NTIS $5.00.

Declassified 18 Jun 1973.

The objectives of SNAP 2/10 reactor system; analysis; and system, component, and fuel development are discussed. The one-piece fuel element (without end reflectors) was selected as the reference element for both SNAP 2 and 10 reactors. Analysis of SNAP 2/10 reactors under accident conditions involving water immersion and reflection was made. A breadboard circuit for the reactor control system was assembled and operated. Design layouts for the SNAP 2 shield assembly were started. A full-size S2-DR-type (SNAP 2 Development Reactor) fuel element has been assembled into an irradiation test capsule for run in the WTR (Westinghouse Test Reactor). (auth)

12117 (NAA-SR-6994) PROGRESS REPORT SNAP 2/10 REACTOR, OCTOBER–DECEMBER 1961. Haussler, W. M. (ed.) (Atomics International, Canoga Park, Calif.). 30 Jun 1962. Contract AT(11-1)-Gen-8. 53p. Dep. NTIS $4.75.

Declassified 18 Jun 1973.

Progress is reported on reactor system analysis and development. Also included is progress in the development of control systems, cores, shielding, and high-temperature systems. (FS)

12118 (NAA-SR-10245) INTERIM REPORT ON THE SNAP CRITICAL ASSEMBLY 4A (SCA-4A) EXPERIMENTAL RESULTS. Clifford, D. W. (Atomics International, Canoga Park, Calif.). 20 Mar 1965. Contract AT(11-1)-GEN-8. 45p. Dep. NTIS $4.25.

Declassified 3 May 1973.

The SCA-4A reactor assembly has provided incremental reactivity worth information for beryllium reflectors of varying thicknesses and lengths. The axial and radial worth functions generated indicated that the functions are generally separable and may be used to predict the worth of an arbitrarily selected reflector configuration within ±10%. The effects of relative movements between the core and reflector are included in these measurements. Various reactor control devices were studied from the standpoint of reduced shielding requirements and increased effectiveness of control. A split counter-rotating drum and a vertically sliding drum appear to meet the objectives. A series of core material reactivity worth measurements was made which included cladding material, poison, and in-core instrumentation studies. (auth)

12119 (NAA-SR-11496) PROGRESS REPORT FOR SNAP (SYSTEMS FOR NUCLEAR AUXILIARY POWER) GENERAL SUPPORTING TECHNOLOGY, MAY–JULY 1965. Mims, L. S. (Atomics International, Canoga Park, Calif.). 30 Sep 1965. Contract AT(11-1)-Gen-8. 29p. Dep. NTIS $3.50.

Declassified 24 May 1973.

Progress is reported on technical assistance given to SNAP programs on nuclear and control analysis, core configuration experiments, shielding analysis, and basic heat and mass transfer. (FS)

12120 (NAA-SR-11637) NON-NUCLEAR PERFORMANCE TESTING SNAP 8 EXPERIMENTAL REACTOR FUEL ELEMENTS FINAL REPORT. Fitzgerald, A. J.; La Scalla, F. A. (Atomics International, Canoga Park, Calif.). 25 Mar 1966. Contract AT(11-1)-Gen-8. 73p. Dep. NTIS $5.75.

Declassified 18 Jun 1973.

Non-nuclear performance tests were performed on 54 SNAP 8 Experimental Reactor (S8ER) design fuel elements. The performance tests were simulations of anticipated reactor conditions, including thermal and mechanical inputs. Performance of the fuel elements is based on the hydrogen loss, or permeation rate, at a specified temperature. The test data, which show significantly increased hydrogen permeation caused by pre-endurance thermal cycling and ramp heating, but not by vibration, shock, and acceleration are summarized. There was a marked improvement in the hydrogen barrier during 10,000 hr of thermal endurance. Postendurance test results show the behavior of the hydrogen barrier was similar to the behavior during pre-endurance tests. That is, thermal cycling and ramp heating caused an increase in permeation, while a second endurance test resulted in a marked decrease in permeation. These results show that the variation between the nuclear operation of the S8ER and this test program prevents a detailed step-by-step comparison of the hydrogen loss of the performance test fuel elements with that of the S8ER fuel elements. The test results of this program show fuel elements of the S8ER design (or equivalent), operating at 600 kW(t) in a flight reactor, would be expected to have an average hydrogen loss of about 6 wt % after 10,000 hr of stable operation. (auth)

12121 (NAA-SR–11886(Vol.1)) SNAP SYSTEMS IMPROVEMENT PROGRAM: MERCURY RANKINE PROGRAM. Progress Report, January–March 1966. (Atomics International, Canoga Park, Calif.). 15 May 1966. Contract AT(11-1)-GEN-8. 61p. Dep. NTIS 15.25.

Declassified 31 Oct 1972.

12122 (NAA-SR–11898) SNAP 8 PROGRESS REPORT, FEBRUARY–APRIL 1966. Mason, D. G. (Atomics International, Canoga Park, Calif.). 15 Jul 1966. Contract AT(11-1)-Gen-8. 174p. Dep. NTIS $10.75.

Declassified 24 May 1973.

The detailed analysis and evaluation of the S8ER fuel elements and their irradiation experiments are discussed. Evaluation of S8ER components was continued and used to provide reactor performance and reliability estimates. Results of the S8ER evaluation were applied to the design and analysis of S8DS. (FS)

12123 (NAA-SR–11962) PROGRESS REPORT FOR SNAP GENERAL SUPPORTING TECHNOLOGY, FEBRUARY–APRIL 1966. Mims, L. S. (Atomics International, Canoga Park, Calif.). 15 Jun 1966. Contract AT(11-1)-GEN-8. 62p. Dep. NTIS $5.25.

Declassified 17 Apr 1973.

12124 (NAA-SR-12020) SNAP REACTOR IMPROVEMENT PROGRAM. Progress Report, April–June 1966. Maki, L. M. (Atomics International, Canoga Park, Calif.). 15 Aug 1966. Contract AT(11-1)-GEN-8. 104p. Dep. NTIS $7.25.

Declassified 17 Apr 1973.

Progress is reported on analytical and developmental studies to evaluate methods to improve uranium–zirconium hydride reactor performance. (FS)

12125 (SLA-73-221) FEASIBILITY STUDY ON FAST-ACTING VALVES FOR AIRBORNE NUCLEAR CONTAINMENT SYSTEMS. Scott, W. F. (Sandia Labs., Albuquerque, N. Mex.). Jun 1973. 33p. Dep. NTIS $3.00.

The feasibility of developing fast-acting valves to seal the coolant lines emanating from a reactor used to power aircraft was studied. The valves must be made integral with the wall of a hardened containment sphere in such a way that the structural integrity of the sphere is unimpaired in the event of a crash. (auth)

Reactor Safety and Environmental Aspects

Refer also to abstracts 10781, 10782, 10896, and 10897.

12126 (BAW-10035(Rev.1)) FUEL ASSEMBLY STRESS AND DEFLECTION ANALYSIS FOR LOSS-OF-COOLANT ACCIDENT AND SEISMIC EXCITATION. DeMars, R. V.; Steinke, R. R. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Dec 1972. 7p.

Babcock & Wilcox has evaluated the capability of the fuel assemblies to withstand the effects of a loss-of-coolant accident (LOCA) blowdown, the operational basis earthquake (OBE) and design basis earthquake (DBE), and the simultaneous occurrence of the DBE and LOCA. This method of analysis is applicable to all of B&W's nuclear steam system contracts that specify the skirt-supported pressure vessel. Loads during the saturated and subcooled phases of blowdown following a loss-of-coolant accident were calculated as described. This LOCA loading is also applicable to all skirt-supported vessels. The seismic excitations will be determined for each reactor site. However, the description of reactor components, the analytical model, testing, and LOCA loadings is generally applicable. The maximum loads on the fuel assemblies were found to be below allowable limits, and the maximum deflections of the fuel assemblies were found to be less than those that could prevent the insertion of control rods or the flow of coolant through the core. Based on the results of this investigation, it is concluded that the fuel assemblies can withstand the loss-of-coolant accident and seismic excitation loadings individually, as well as a simultaneous LOCA and DBE, without exceeding allowable limits. (auth)

12127 (BP-TOP-1) SEISMIC ANALYSIS OF PIPING SYSTEMS. (Bechtel Power Corp., San Francisco, Calif. (USA)). Apr 1973. 50p.

The seismic analysis of seismic Category I piping systems is illustrated. It reflects present Bechtel practice. Response spectrum method is the computational technique used in the analysis. The analytical procedures for rigid and flexible piping systems are discussed. In addition, some simplified analytical approaches are also included. The criterion of stress combination due to different loading conditions (e.g., seismic, thermal or weight) is described in accordance with the standard industrial codes, (ASME Section III or ANSI B31.1). All AEC concerns relative to seismic analysis of piping systems have been addressed. (auth)

12128 (CONF-730801-3) REVIEW OF SAFETY-RELATED OCCURRENCES FROM A MATERIALS PERFORMANCE POINT OF VIEW. Scott, R. L. Jr. (Oak Ridge National Lab., Tenn.). 1973. 13p. Dep. NTIS $3.00.

From symposium on materials performance in operating nuclear systems; Ames, IA, USA (28 Aug 1973).

Safety related occurrences—failures, incidents and deficiencies—reported by light water reactor nuclear power plants are reviewed. The period covered is 1967 through 1972. The items selected for review were limited to those in which a material failure was involved. Tables were prepared for each year which indicate the facility and components involved, the cause of failure, and the area in which the deficiency originated, i.e., material selection, design, fabrication, installation, operation, or maintenance. The tables are discussed, and areas where additional efforts can be made to improve materials performance are indicated. (auth)

12129 (EUR-4820(Vol. 5)(Pt. K)) PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY, BERLIN, GERMANY, 20-24 SEPTEMBER 1971. Vol. 5. Reactor Plant Structures and Containment, Part K. Seismic Response Analysis of Nuclear Power Plant Systems. Jaeger, T. A. (comp.) (European Communities, Brussels (Belgium). Commission; Bundesanstalt fuer Materialpruefung, Berlin (West Germany)). Mar 1972. 343p. (In several languages). (CONF-710903-(Vol. 5)(Pt. K)). EUR.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (F. R. Germany) (20 Sep 1971).

Seventeen contributed papers together with the discussions, as well as the summaries of five invited lectures are contained in the proceedings. Separate abstracts have been prepared for the seventeen original papers. (FS)

For abstracts of individual papers see: 10781, 10782, and 12130–12144.

12130 (EUR-4820(Vol. 5)(Pt. K), pp 19-34) STRONG MOTION EARTHQUAKES AND THEIR EFFECTS ON NUCLEAR POWER PLANTS. Matthiesen, R. B. (Univ. of California, Los Angeles). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

UCLA has been studying the effects of earthquakes on nuclear power plants. Structural vibrators, hydraulic rams, and explosive blasts have been used to excite reactor structures and equipment. Many of the systems tested respond nonlinearly at high force levels. Since linear elastic theory is commonly employed to predict earthquake response, knowledge of nonlinear behavior at high force levels is an important aspect of reactor safety studies. Experimental data on full-scale systems are limited due to the difficulty of inducing high level response. Two methods have been tried for exciting reactor equipment to levels of response approaching strong motion earthquakes. One method uses a hydraulic ram to produce a large static displacement of equipment such as a steam generator or a pipe. When the displacing force is suddenly removed, the equipment undergoes large amplitude free vibrations. Another technique uses explosives placed in the soil adjacent to the reactor containment building. Tests have been performed with up to one ton of high explosive detonated within one hundred meters of a reactor containment building. The 9 February 1971 San Fernando earthquake (M = 6.5) tripped seismic instrumentation at the UCLA and San Onofre reactors. Since tests have been made at both reactors, there is an opportunity to compare vibration test results, analytical results, and response measured during the earthquake. (auth)

12131 (EUR-4820(Vol. 5)(Pt. K), pp 35-68) EARTHQUAKE CALCULATIONS: THEIR IMPORTANCE WITH RESPECT TO AREAS OF AVERAGE AND LOW SEISMIC ACTIVITY AND THE APPLICATION OF COMPUTER ORIENTED METHODS. Huber, A. E.; Schildknecht, P. O. (SDK Ingenieurunternehmen fuer spezielle Statik, Dynamik und Konsstruktion GmbH, Loerrach, Ger.). Mar 1972. (In German and English).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

In the past design criteria for earthquake resistant conventional structures in areas of low and medium seismic activities have been semi-empirical. Even though these estimates are adequate for most conventional structures they appear not to be sufficient to more involved structures such as nuclear power plants. It is therefore appropriate to undertake a more thorough investigation for this class of structure. A critical appraisal of earthquake design suggests the consideration of two main points which should be kept in mind throughout every rigorous analysis. On the one hand there is the potential danger of nuclear power plants. This fact becomes more important if the site is located in a populated area. Therefore, in order to reduce this risk to an absolute minimum, safety requirements have to be high. On the other hand, however, unreasonably high safety factors should be avoided from the economical point of view. A more thorough analysis based on the general dynamic problem is presented. The general formulation includes the response spectrum modal analysis and time history modal analysis in order to solve seismic problems. A survey on the generation of response spectra and time histories, especially with respect to areas of low and medium seismic activities, is presented. The necessity of seismic response analysis is demonstrated by response spectra and by a numerical example. A useful method is presented to solve the general eigenvalue problem arising in structural dynamics. The method is an energy minimization method and is therefore very efficient for large systems stemming e.g. from a finite element analysis. (auth)

12132 (EUR-4820(Vol. 5)(Pt. K), pp 69-91) ASEISMIC DESIGN OF STRUCTURES WITH NUCLEAR REACTORS: METHOD OF EARTHQUAKE RESPONSE ANALYSIS FOR COMPOSITE STRUCTURES EVALUATED FOR DAMPING EFFICIENCIES BY MATERIAL AND STRUCTURE TYPE. Tsushima, Y.; Jido, J. (Takenaka Komuten Co. Ltd., Tokyo). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Analytical procedures which have been employed in the evaluation of dynamic properties and dynamic response values for earthquake motions putting emphasis on estimating the damping capacities of a special structure like a nuclear power plant which is made of various materials such as concrete, steel, special alloys, etc., and various structural types such as walls, shells, frames, and trusses, are summarized. The interactions between the foundation of the structure and the ground at the time of the earthquake are considered. The formulation of equations is discussed including the procedures for defining the complex stiffness matrix by which the damping capacities of structures can be estimated as hysteric damping. Techniques for solving the eigenvalue equation and the proof of orthogonality properties of the complex stiffness matrix are discussed. The numerical results of dynamic properties and dynamic response analyses are obtained by using computer program based on the above mentioned theory using earthquake motions for a nuclear power plant to be constructed in Japan. Further considerations and discussions of usage are presented. (auth)

12133 (EUR-4820(Vol. 5)(Pt. K), pp 93-108) ASEISMIC DESIGN OF NUCLEAR REACTOR BUILDING: STRESS ANALYSIS AND STIFFNESS EVALUATION OF THE ENTIRE BUILDING BY THE FINITE ELEMENT METHOD. Tsushima, Y.; Hayamizu, Y.; Nishiyama, K. (Takenaka Komuten Co. Ltd., Tokyo). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The spatial characteristics of stress and stiffness of a nuclear reactor building having a complex wall arrangement are evaluated by the finite element method. The method of analysis is explained. Using this method, the interaction effect between the wall and the shell, the axial effect of the wall at right angles to the direction of lateral force, and stress distribution of each wall and shell can be obtained. An analysis example is shown in detail. This example is of an actual nuclear reactor building and analysis is performed in order to design this building. Stiffness evaluation has been performed by using the bending-shear theory. Results of stiffness evaluation obtained by using the method explained in this paper are compared with that of the bending-shear theory. (auth)

12134 (EUR-4820(Vol. 5)(Pt. K), pp 109-122) ASEISMIC DESIGN FOR JAPAN EXPERIMENTAL FAST REACTOR (JOYO). Akino, K.; Kato, M. (Japan Atomic Power Co., Tokyo). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The aseismic design of the Japan Experimental Fast Reactor (50 MWt) called "JEFR" or Japanese nickname "JOYO" which is being constructed at Oarai site in Ibaragi Prefecture, along the shore of the Pacific Ocean is explained. Fundamental design requirements were fixed and some interesting design activities have been continued. The decision of the design earthquake, idea of plant layout, explanation of dynamic analyses of the main items, design modification of the safety rods, recipe for making flood response spectra, the problem of sodium coolant piping and the graphite shielding structure are considered. (auth)

12135 (EUR-4820(Vol. 5)(Pt. K), pp 123-139) CALCULATION OF VIBRATIONS OF STRUCTURES CAUSED BY EARTHQUAKES USING THE FINITE ELEMENT METHOD: MECHANICAL MODELS OF NUCLEAR POWER PLANTS. Marguerre, K.; Schalk, M.; Woelfel, H. (Technische Hochschule, Darmstadt, Ger.). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

For the analysis of seismic vibrations, complex structures are usually idealized by lumped parameter models. With the finite element method, however, natural frequencies as well as forced vibrations can be calculated with higher accuracy. Here deflections are used as generalized coordinates. The elements used are beams with bending flexibility in two planes under consideration of shear deformation and rotational inertia. Torsion, normal strain, initial stress and elastic foundation may be taken into account. The element stiffness- and mass-matrices are found using the principle of virtual displacements. For the calculation of forced vibrations the method can be combined with the response spectrum modal analysis as well as with the time history modal analysis. The choice of the mechanical model of the structure is of high influence on the quality of the seismic analysis. The basic considerations for selecting the mechanical model of buildings and equipment are discussed and models are demonstrated for several nuclear power plant structures. Special attention is given to the interaction between building and equipment. (auth)

12136 (EUR-4820(Vol. 5)(Pt. K), pp 141-154) STATISTICAL TREATMENT OF SEISMIC LOADING ON REACTOR BUILDINGS AND EQUIPMENTS. Amin, A.; Ang, A. H. S. (Univ. of Illinois, Urbana). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A statistical approach for the seismic analysis and design of nuclear reactor buildings and facilities is proposed. The concepts are derived through random vibration theory; a comparison of specific results obtained on this basis with those obtained for a normalized set of record accelerograms attests to the validity of the proposed statistical approach. (auth)

12137 (EUR-4820(Vol. 5)(Pt. K), pp 175-194) INFLUENCE OF SEISMIC PULSE TIME ON STRUCTURE-FOUNDATION INTERACTION. Scavuzzo, R. J. (Rensselaer Polytechnic Inst. of Connecticut, Inc., East Windsor Hill); Little, R. R. Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The influence of the duration of seismic ground motions on inertia forces of a power plant is investigated considering ground-structure interaction effects. This study is based on the ground accelerations measured during the 1940 El Centro earthquake and the 1952 Taft earthquake. Results of the analysis indicate that ground motions from five to ten seconds in length are sufficient to evaluate seismic forces on heavy structural components. (auth)

12138 (EUR-4820(Vol. 5)(Pt. K), pp 211-233) SOIL-FOUNDATION INTERACTION OF REACTOR STRUCTURES SUBJECT TO SEISMIC EXCITATION. Lee, T. H.; Wesley, D. A. (Gulf General Atomic, Inc., San Diego, CA). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A theoretical investigation was conducted to study the soil-structure dynamic interaction effects on the seismic response of reactor structures. The analysis was made by considering a linear, damped, unsymmetric, three-dimensional flexible structure coupled with an elastic, homogeneous, isotropic half-space. The model is capable of handling multi-component ground excitation input and accounting for additional ground effects, such as the through-soil coupling between translation and rocking motion. Numerical results for some example problems dealing with a prestressed concrete reactor vessel (PCRV) are presented in terms of both transient and steady-state responses. The seismic behavior of reactor structures was found to differ considerably from that exhibited by ordinary buildings. Significant interaction effects were observed for various cases which have not been previously analyzed. (auth)

12139 (EUR-4820(Vol. 5)(Pt. K), pp 235-256) DYNAMIC CALCULATIONS USING A FRAMEWORK ANALOGY TO PREDICT THE SEISMIC RESPONSE OF A NUCLEAR REACTOR. Jobson, D. A. (United Kingdom Atomic Energy Authority, Risley, Eng.). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The feasibility of predicting the response of a nuclear reactor system to a spectrally defined earthquake is established in the context of a particular example. The associated dynamic calculations were carried out on FRAMES, which is a UKAEA Reactor Group program for the vibration analysis of skeletal structures. Although the pipework and framed structures could be represented quite directly in this way, further work was needed to simulate other components, such as the reactor vessel and core. The use of grid-framework methods in this connection is described, as is their application to the modelling of the ground state strata supporting the reactor. The complexity of the combined system led to the use of physical partitioning, and full advantage was taken of a number of rationalizations which this technique suggested. The analysis demonstrated that soil/structure interaction introduced significant extra degrees of freedom. The associated modal shapes involved simultaneous sideways movement and rocking of the raft, at frequencies which depended primarily on the values used for the soil moduli, thus emphasising the need for reliable data on the latter. (auth)

12140 (EUR-4820(Vol. 5)(Pt. K), pp 257-279) PARAMETRIC ANALYSIS OF SOIL-STRUCTURE INTERACTION FOR A REACTOR BUILDING. Whitman, R. V.; Christian, J. T.; Biggs, J. M. (Massachusetts Inst. of Tech., Cambridge). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A reinforced concrete reactor building to be located over deep soil deposits is analyzed to determine the effects of varying flexibility of the soil and variable damping. The soil structure interaction is shown to be significant, the stiffest foundation gives the most critical results for all responses except those of the base itself. The interaction of the first three structural modes and the soil is complicated, but in general the first mode dominates the outer structure, and the second and third modes dominate the inner structures. When damping is allowed to vary among the components of the system, the results indicate that the conventional appraoch of constant damping in all modes is conservative. (auth)

12141 (EUR-4820(Vol. 5)(Pt. K), pp 283-298) SEISMIC DESIGN COEFFICIENTS OF EQUIPMENT IN NUCLEAR POWER PLANTS. Lin, C. W. (Westinghouse Electric Corp., Pittsburgh). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Seismic coefficients for the design of equipment in nuclear power plants have been shown to be proportional to the single degree response spectrum. Using the two degree response spectra, constructed according to a numerical time integration study for the El-Centro 1940 N–S earthquake obtained by previous investigators, equipment seismic design coefficients for other earthquakes can be easily computed using present theory. (auth)

12142 (EUR–4820(Vol. 5)(Pt. K), pp 299-318) ASEISMIC DESIGN OF ASYMMETRIC STRUCTURES AND THE EQUIPMENT CONTAINED. Chen, C. (Gilbert Associates Inc., Reading, PA). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The dynamic structural response is a function of these basic assumptions regarding seismic input soil structure interaction, structural and dynamic properties of buildings, etc. A general review of the current assumptions is included. The linear dynamic analysis of a coupled stubby asymmetric building of a nuclear power plant is presented as an example. Each floor of the building is modeled as a diaphragm rigid in its own plane. Consequently three dynamic degrees of freedom are assigned to each diaphragm, two translational in its own plane and one rotational about the vertical axis. The equipment installed in the building must be designed dynamically to insure safe shutdown in case of an accident caused by the possible strong-motion earthquake. Conventionally single "floor design spectrum" at each floor level is used to design the equipment. However, due to the rotational effect, the structural response varies from point to point on the same floor. Two "floor design spectra" corresponding to two translational degrees of freedom of the diaphragm are obtained for each directional input. (auth)

12143 (EUR-4820(Vol. 5)(Pt. K), pp 319-328) DYNAMIC ANALYSIS OF VITAL PIPING SYSTEMS SUBJECTED TO SEISMIC MOTION. Chen, C. (Gilbert Associates Inc., Reading, PA). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The linear dynamic analysis of the three dimensional piping system of a nuclear power plant is based on a lumped parameter model. Both time-history input and design spectrum input are used and discussed. Also both dynamic stiffness matrix and flexibility matrix are employed in the eigenvalue problem and in calculating internal stresses and support reactions. The interaction of piping with the structure can be treated either by floor design spectrum or by combining them into one model. (auth)

12144 (EUR-4820(Vol.5)(Pt.K), pp 329-343) SEISMIC RESPONSE SPECTRA FOR EQUIPMENT DESIGN IN NUCLEAR POWER PLANTS. Biggs, J. M. (Massachusetts Inst. of Tech., Cambridge). Mar 1972.

From first international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Floor response spectra for the seismic analysis of equipment are generated by a very simple, generalized method based on the ground response spectrum and the results of a response spectrum analysis of the supporting structure. In this method, the effects of the structure's modes are computed separately and then combined by an empirical procedure. As compared to the alternative time-history approach to the construction of floor response spectra, the proposed method is not only much more simple in application, but is believed to be more reliable than the former when only a few time-histories of ground motion are used. The validity of the method is demonstrated by comparison with results derived from actual recorded ground motions. (auth)

12145 (NAA-SR–6958) SNAP 8 EXPERIMENTAL REACTOR (S8ER) FINAL SAFEGUARDS SUMMARY REPORT. Piccot, A. R. (ed.). Atomics International, Canoga Park, Calif.). 28 Feb 1962. 87p. Dep. NTIS $6.50.

Declassified 3 May 1973.

The final safeguards summary for the S8ER reactor presents a brief description of the site, surrounding environment, facility, reactor, and the associated process and control systems. Normal and potential hazards and built-in safety features are evaluated to show that the reactor can be operated safely and will not produce any undue hazards to either the general population, operating personnel, or adjoining test facilities, and personnel. (FS)

12146 (ORNL-TM-4148) LMFBR SAFETY AND CORE SYSTEMS PROGRAMS PROGRESS REPORT FOR JANUARY–FEBRUARY 1973. Fontana, M. H. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 70p. AT $5.45.

Research progress in the LMFBR safety and core systems program during January and February 1973 is reported. The research covered Failed Fuel Mockup (FFM) facility operations, water system mockup of the FFM, computer calculations of bundle 3A performance, FFM dynamic testing and noise analysis, and heater development. The program coordination with other laboratories is discussed. (JWR)

12147 (ORO–4067-4) THERMAL EFFECTS OF THE SURRY NUCLEAR POWER PLANT ON THE JAMES RIVER, VIRGINIA. Part III. Results of Monitoring Physical Parameters of the Environment Prior to Plant Operation. Special Report in Applied Marine Science and Ocean Engineering Number 33. Shearls, E. A.; Chia, S. N.; Hargis, W. J. Jr.; Fang, C. S.; Lobecker, R. N. (Virginia Inst. of Marine Science, Gloucester Point). Feb 1973. Contract AT(40-1)-4067. 363p. Dep. NTIS $10.60.

One of the primary objectives of this work was to identify existing environmental conditions that could be used to support or compare the post-operation temperature patterns associated with heated water discharges into the estuary. Two years field data, collected with a boat monitoring system, are presented. The data indicate that the average monthly change in water temperature and salinity followed the same pattern both years (1971 and 1972). (ERB)

12148 SOIL-STRUCTURE INTERACTION OF NUCLEAR REACTOR STRUCTURES CONSIDERING THROUGH-SOIL COUPLING BETWEEN ADJACENT STRUCTURES. Lee, T. H.; Wesley, D. A. (Gulf General Atomic Co., San Diego, CA). Nucl. Eng. Des.; 24: No. 3, 374-387(1973).

The theoretical problem concerning the influence of through-soil coupling between adjacent structures on the seismic loading of nuclear reactors was investigated by considering a soil–structure interaction model in which several three-dimensional flexible structures are bonded to an elastic half-space. These structures, which are allowed to be either similar or dissimilar, are modeled as conventional discrete systems mounted on separate base slabs of close proximity. It is assumed that the stiffness of any structure such as piping connecting the adjacent buildings is negligible. For comparison, the seismic responses of structural masses are determined both with and without the influence of nearby structures. Both transient and steady-state results are presented and discussed for some typical simplified two- and three-structure complexes. Emphasis is placed on the effects of through-soil coupling on the dynamic response of the system rather than actual magnitudes of response which have previously been treated for plants erected on a single base slab. The significant findings are that nuclear power plants can be designed to achieve a reduction in seismic loads due to interaction with neighboring structures. Conversely, improper plant design and layout may result in mutual reinforcement of resonances with increased loads. (auth)

Reactor Theory and Calculation

Refer also to abstracts 11861, 12074, and 12079.

12149 (AEEW-R–816) XENFER: A FORTRAN CODE FOR THE CALCULATION OF SPATIAL TRANSFER FUNCTIONS OF THERMAL REACTORS SUBJECT TO XENON POISON EFFECTS. Owens, D. H. (Atomic Energy Establishment, Winfrith (England)). Feb 1973. 64p. Dep. NTIS (U. S. Sales Only) $5.25.

The computer code XENFER calculates frequency responses suitable for designing spatial control schemes to counter xenon poison effects in thermal nuclear reactors. Given a prescribed form of sectorized control actuation intended for use in a cylindrical reactor core, XENFER provides the frequency response resulting from the case of a prescribed observation system. The one- or two-energy-group diffusion equations with feedback are described together with the method of solution based on the combined use of mesh-point and synthesis modes. Appropriate axial xenon synthesis modes are derived and the error in reactivity feedback due to this approximation is calculated. (auth)

12150 (AEEW-R–839) TRICEPS: A THREE DIMENSIONAL COLLISION PROBABILITY COMPUTATIONAL SUITE. Harris, D. W. G. (Atomic Energy Establishment, Winfrith (England)). Feb 1973. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

TRICEPS is a suite of two independent, self contained WIMS"E" modules for calculating collision probabilities in three dimensional geometries. The common root between the two modules of TRICEPS and the other WIMS"E" modules, is that of the standard set of five interface files used by all WIMS"E" modules. The two modules of the TRICEPS suit are 3D-COP and FILM, the former calculates the self collision and escape probabilities of smeared three dimensional cells while the latter combines these with the

surface to surface area of contact matrix to produce a full collision probability matrix. Input to both modules is via WIMS"E" Interfaces 3 and 4 and the card reader and output is to the WIMS"E" Interface file 5 and the line printer. (auth)

12151 (BNWL-SA-4708) NATURE OF FISSION AND THE CRITICALITY PROCESS (FROM PROTACTINIUM TO CALIFORNIUM AND BEYOND). Clayton, E. D. (Battelle Pacific Northwest Labs., Richland, Wash.). 1973. 29p. Dep. NTIS $3.50.

Similarities and differences between the shell models for the atom and the nucleus have been used in a simple qualitative manner to explain in familiar concepts the interaction of neutrons with the actinide elements. Critical masses range from g to kg quantities depending on the nuclear make-up of the actinide element. Criticality is a complex thing–all factors affecting the interaction of the neutron with the nucleus enter in. Several examples were cited in point of illustration, the "triple point" of criticality, apparent anomaly regarding density and effect of added scatterers, the "zero mass concept" in which criticality could be achieved with less than one ounce of ^{239}Pu. The table on Slow Neutron Fissionability and Criticality relates differences and/or correspondences between fissionability, (Z^2/A), activation energy, and the energy available on absorption of a thermal neutron with the known data now available on criticality. The actinide isotopes are classified "fissile" or "fissionable" to facilitate discussion of their criticality aspects. It would be possible to achieve criticality with a second naturally occurring element– Protactinium ($^{231}_{91}$Pa)–analogous to $^{237}_{93}$Np. Comparisons of the kind presented can be used to predict the likelihood of obtaining criticality for an isotope on which no criticality data exist. The empirical correlation of k_∞ vs. energy difference suggests that it is possible to provide an estimate of k_∞ for any even-n nuclide without knowledge of either cross section data or ν, on which criticality depends. Based on the properties of the superheavy "magic" nuclei (as yet undiscovered, but theoretically predicted, and actively sought) an estimate has been provided (on simple qualitative grounds) for critical mass. If the mysterious and illusive element "X" should ever be found, or produced, it might well have a minimum critical mass of the order ~0.5 g. (auth)

12152 (EUR–4945) INVESTIGATION OF THE PARALLEL-FLOW INDUCED VIBRATION IN A THREE-ROD FUEL BUNDLE. Ohlmer, E.; Schwemmle, R. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 1973. 50p. (In German). Dep. NTIS (U. S. Sales Only) $4.50. EUR BF 60,-.

The parallel-flow induced vibration in fuel rod structures have been investigated on a three-rod bundle in water flow. The study is based on an analytical model relating the vibration amplitudes to the driving forces of the pressure fluctuation in the boundary layer. The experimental results show, that the bundle arrangement influences strongly both the vibration behavior of the rods and the turbulence structure of the flow. The most significant statistical characteristics of the pressure fluctuations in the subchannels of the rod bundle have been determined for various parameters. (auth)

12153 (MRR–114) ASSEMBLY AND INPUT OF MONTE CARLO PROGRAM KENO-II. Weber, W. J. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Dec 1972. 48p. (In German). Dep. NTIS (U. S. Sales Only) $4.50.

KENO-II is a Monte-Carlo nuclear criticality program, which is easy to use. It shows all important properties of modern Monte-Carlo programs: Neutron weighting, Russian Roulette and Splitting, use of multigroup constants, 1st order anisotropic scattering, capable geometry routines, and the albedo method. The results of test calculations are discussed. The program description presents detailed input instructions together with sample problems. (auth)

12154 OPTIMIZATION METHODS OF NUCLEAR REACTOR SYSTEMS. Hara, F. (Tokyo Univ.). Rep. Inst. Ind. Sci., Univ. Tokyo; 21: No. 4, 1-57(Oct 1972). (In Japanese).

The optimization of nuclear reactor systems from the statistical point of view is discussed. For the improvement of performance and safety of nuclear reactors, it is very important to develop the statistical optimization method for the nuclear reactor system. First of all, with the classification of reactor optimization problems and their outline are described. Stochastic theory of neutron transport is completely expanded by using theory of Markov branching process, and statistics of neutron flux is obtained for one-point reactor model and spatial reactor model. The one-point model shows clearly effect of delayed neutrons and temperature feedback to the statistics of neutron flux. Optimization techniques are developed, and it was found that Mode Optimization Technique is very powerful to the optimization of distributed parameter system such as nuclear reactors. Using average and two kinds of variance of the neutron flux, maximization of average power output is formulated under the condition of making uncertainty of the neutron flux as small as possible, with the aid of the Mode Optimization Technique. Numerical results show that optimal distribution of the average neutron flux is not always flat, when the uncertainty of neutron flux is taken into consideration as the loss of safety or reliability of nuclear reactors. (JA)

Reactor Components and Accessories

Refer also to abstracts 11218, 11226, 11241, 11244, 11277, 11279, 11325, 11329, and 12491.

12155 (ANL-7985) LARGE-DEFORMATION PLASTIC RESPONSE OF HEXAGONS TO PRESSURE PULSES. Youngdahl, C. K. (Argonne National Lab., Ill.). Mar 1973. Contract W-31-109-eng-38. 57p. Dep. NTIS $5.45.

An analytical study is performed to determine the dynamic plastic response of a hexagonal subassembly duct to an internal pressure pulse of arbitrary shape. The analysis includes plastic distortion of the cross-section and large-deformation geometric effects that result in redistribution of the internal forces between bending and membrane stresses in the hexagon wall. A description of the analytical model, details of the calculational procedure and computer programs used to obtain numerical results, an approximate closed-form solution valid in the small-deformation range, and some typical results are presented. (auth)

12156 (CONF-730801-1) MATERIALS PROBLEMS FROM THE REACTOR OPERATOR'S POINT OF VIEW. Cox, J. A.; Binford, F. T. (Oak Ridge National Lab., Tenn.). May 1973. 36p. Dep. NTIS $4.00.

From symposium on materials performance in operating nuclear systems; Ames, IA, USA (28 Aug 1973).

Reactor operators' experience with materials problems extending over the past 27 years is reviewed. Some radiation damage problems and their effects on operations are discussed along with other materials problems which are exacerbated by radioactivity or contamination problems. These include corrosion, in-service inspection and surveillance, and maintenance. (auth)

12157 (EUR-4820(Vol.6)(Pt.M)) PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY, BERLIN, GERMANY, 20–24 SEPTEMBER 1971. Vol. 6. Structural Analysis and Design. Part M. Design, Reliability, Computation Methods. Jaeger, T. A. (comp.) (European Communities, Brussels (Belgium). Commission; Bundesanstalt fuer Materialpruefung, Berlin (West Germany)). Mar 1972. 566p. (In Several Languages). (CONF-710903(Vol.6)(Pt.M)). EUR.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (F.R. Germany) (20 Sep 1971).

Twenty-eight papers presented at the conference are included. A separate abstract was prepared for each paper. (LCL)

For abstracts of individual papers see: 10783–10793, 10799–10802, 12049, 12052, 12056, 12057, and 12158–12166.

12158 (EUR-4820(Vol.6)(Pt.M), pp 37-56) SAFETY FACTORS AND PROBABILITY IN LIMIT STATE DESIGN OF STRUCTURES. Burnup, T. E.; Barrett, N. T. (United Kingdom Atomic Energy Authority, Risley, Eng.). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Attempts to associate safety factors with probabilities of failure depend upon knowledge of the variability of all the parameters which affect the relationship between the stresses in the structure and the strength of its component materials. While reasonable information can be obtained on the variability of materials there are few statistics available concerning the parameters causing variability of stress. A way around this difficulty is suggested by considering a well known type of structure such as a building and associating the design methods and safety factors commonly used with an assessment of the failure rate for buildings. It then becomes possible to deduce the variability of stresses which would be consistent with both this relationship and the known variability of the materials and so to establish a more general relationship between safety factors and probability of failure. A reactor containment structure must cater for a whole series of accidents, each of which has a different probability of occurrence and for each of which the consequences of structural failure will differ.

It would be desirable to have a design method which could enable safety factors to be chosen so that the combined probability of the accident happening and the structure failing can be matched to the acceptable probability of failure for each accident. A possible method of doing this is suggested. (auth)

12159 (EUR-4820(Vol.6)(Pt.M), pp 57-70) DESIGN OF PRESSURE VESSELS TO PROBABILISTIC CRITERIA. Smith, C. O. (Univ. of Detroit). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The engineering profession has become increasingly concerned with the adequacy of design calculations. This concern indicates a need for critical evaluation of designs based on arbitrary multipliers, such as safety factors or worst-case treatment. Design has customarily been based on applied loading, geometry, and handbook property values to give a deterministic solution. Equations are presented for the mean and standard deviations of stresses developed in thick-wall cylinders and spheres subjected to internal and external pressure. Inherent in these equations are the facts that design variables are generally characterized by spectra of values, rather than unique values, and that a small, but finite, probability of failure must be recognized in any design. By coupling the stresses calculated from the equations, through an appropriate theory of failure, with the strength available in a material, reliability can be calculated. Appropriate illustrations are provided. The influence of different ranges (different standard deviations) of variables on the stresses developed is demonstrated. A comparison is made between safety factor and reliability for a number of materials for a given vessel geometry. (auth)

12160 (EUR-4820(Vol.6)(Pt.M), pp 93-104) OPTIMAL COST DESIGN FOR COMPONENT TESTING PROVIDING A PARTICULAR MEASURE OF RELIABILITY ACCURACY. Naegele, G.; Sellinschegg, D. (Kernforschungszentrum, Karlsruhe, Ger.). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Discussed is the problem of choosing statistical designs for component tests aimed at providing data from which the reliability may be calculated. Granted a cost model, and a particular measure of the reliability accuracy, it is shown how a least cost design may be found. The measure of the reliability accuracy which, it is argued, is the one that should be used, is the relative length of the confidence interval for the failure rate. The procedure is illustrated in detail by the example of a nuclear reactor sodium pump. (auth)

12161 (EUR-4820(Vol.6)(Pt.M), pp 105-117) SYSTEM SAFETY ANALYSIS. Mieze, G. (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.). Mar 1972. (In German).

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

An attempt is made to describe the general decision making process in system safety assessment. In this context the criteria necessary and the problem of adequate data generation, handling and retrieval are discussed. A system safety programme to support that effort and to assure the achievement of the safety objectives is discussed. Analysis techniques as a part of that systems safety programme are identified and explained to some extent. Emphasis is placed on the status of reliability in the framework of system safety programme. Special attention will be given to the implementation of analysis techniques to mechanical systems. (auth)

12162 (EUR-4820(Vol.6)(Pt.M), pp 207-228) THERMOVISCOELASTIC AXISYMMETRIC STRESS ANALYSIS BY FINITE ELEMENT AND FINITE DIFFERENCE COMPUTER TECHNIQUES. Gross, H. (Imperial Coll. of Sci. and Tech., London). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

Guidelines for implementing established finite element and finite difference techniques in a mixed method of approach to the computer-aided analysis of transient thermoviscoelastic axisymmetric stress problems as encountered in the design of prestressed concrete reactor pressure vessels are given. The superposition principle as a technique for the theoretical reproduction of the relaxation phenomenon is examined and a relevant function fitting technique using least squares is described. Locally varying constitutive relationships are considered. The inherent difference between elliptic and parabolic systems is explained and the interface between systems analysis and the computer programming functions is simplified by adopting a methodical approach. To make persuasive presentation of a worked example, a few extremal temperature and stress fields are graphically displayed as isometric surfaces drawn over the finite element meshes of the investigated vessel cross-section. (auth)

12163 (EUR-4820(Vol.6)(Pt.M), pp 287-304) APPLICATION OF THE "BERSAFE" FINITE ELEMENT SYSTEM TO NUCLEAR DESIGN PROBLEMS. Hellen, T. K. (Central Electricity Generating Board, Berkeley, Eng.). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

BERSAFE is a general computer system designed to perform the stress analysis of arbitrary two-dimensional and three-dimensional structures using the method of finite elements. The system is currently available for elastic analyses for a large number of different element types, which include plane stress, mathematical and engineering plane strain, axisymmetric and solid three-dimensional structures. Different kinds of loading may be applied, including point loads at nodes, line and pressure loads over edges and faces, body forces, rotational forces and temperature distributions. Degrees of freedom may be restrained from moving or given prescribed values, and a decoupling facility is available allowing cracks to open in tensile regions. Material properties may vary from element to element and be temperature dependent. Auxiliary routines are available for the automatic generation of meshes for all two-dimensional and certain three-dimensional structures, and computer plots may be obtained for stress contours in two-dimensional cases and deformations in all cases. The facilities and element types available are described, together with reasons for adopting a system approach. Examples of various applications which have been analyzed by the system are described. These include a three-dimensional analysis of a podded boiler prestressed concrete pressure vessel containing holes and subjected to internal pressure. The problem of the three-dimensional cylinder-cylinder intersection is also described, including methods of mesh designing and comparisons with experimentally-obtained data. Finally the use of solid three-dimensional elements as thin shells is described including their performance for thin, pressurized cylinders with end restraint, and the wind-loaded cooling tower problem. These indicate the usefulness of the solid elements as thin shells, particularly in plant problems where transitions from thin shells to thicker areas are required and full element compatibility is to be maintained. (auth)

12164 (EUR-4820(Vol.6)(Pt.M), pp 315-335) ASSUMED STRESS HYBRID FINITE ELEMENT MODEL FOR THE ANALYSIS OF AN AXISYMMETRIC THICK-WALLED PRESSURE VESSEL. Appa Rao, T. V. S. R. (Structural Engineering Research Regional Centre, Madras). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

An assumed stress hybrid finite element model for the analysis of axisymmetric solids has been presented and stiffness matrices for triangular and quadrilateral elements are formulated using the principle of minimum complementary energy. A thick sphere and an infinitely long thick cylinder subjected to internal pressure are analyzed by using the assumed stress hybrid model. The stress pattern obtained by using the assumed stress hybrid model is compared with the exact solution and with the stress pattern obtained by using the well known displacement assumption model. The comparison shows that the stress pattern obtained by using the assumed stress hybrid model is somewhat better than the one obtained by using the displacement assumption model. (auth)

12165 (EUR-4820(Vol.6)(Pt.M), pp 365-389) TRIANGULAR THICK PLATE BENDING ELEMENTS. Lynn, P. P. (Univ. of Colorado, Boulder); Dhillon, B. S. Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

A triangular finite element is established which includes transverse shear as well as bending deformations and could be used to predict the behavior of the nuclear reactor circular end plates with circular penetration holes with sufficient accuracy. Three conforming triangular displacement finite elements are developed for thick plate bending analyses. Formulation of these elements is based on Mindlin's higher order plate theory which incorporates the effects of rotatory inertia and transverse shear on the flexural motions of elastic plates. By a comparative study of the three displacement elements, a practical 9 degrees of freedom triangular model is proposed. Since the non-positive-definiteness of triangular element stiffness matrices for thick plate analyses have been encountered by several investigators, the positive-definiteness of the proposed triangular element stiffness matrix is both analytically and numerically examined. The use of this

model has been demonstrated numerically for static bending as well as dynamic response problems. The proposed triangular element predicts the bending behavior of thick plates with good accuracy and efficiency, and is recommended for practical use. (auth)

12166 (EUR-4820(Vol.6)(Pt.M), pp 555-566) RESPONSE OF SHORT CYLINDRICAL PANELS TO RANDOM LOADS. Nash, W. A.; Kanematsu, H. (Univ. of Massachusetts, Amherst). Mar 1972.

From 1st international conference on structural mechanics in reactor technology; Berlin, Federal Republic of Germany (20 Sep 1971).

The problem of response of various structural components of reactors to random loadings is one of increasing importance. The problem of finite amplitude lateral response of a relatively short thin, elastic cylindrically curved panel to a normal loading random with regard to time is investigated. The von Karman type nonlinear equations governing motion of the panel are formulated and the response to random excitation which is a stationary, ergodic, Gaussian white noise is determined by various methods. These include numerical simulation, finite difference procedures, use of the Fokker-Planck relation, and use of equivalent linearization techniques. (auth)

Reactor Fuels

Refer also to abstracts 10805, 11124–11126, 11128, 11129, 11135–11138, 11142, 11174, 11186, 11192–11197, 11209, 11210, 11219, 11229, 11230, 11232–11235, 11238, 11239, 11319–11324, and 11341.

Reactor Control Systems

Refer also to abstract 11140.

12167 (AECL-4427, pp 14-16) FLUX-TILT PROTECTION FOR POWER REACTORS. Allen, V. H. (Chalk River Nuclear Labs., Ont.). Win 1972.

The safeguard fuel in power reactors, measurement of the flux distribution is essential. One way of comparing fluxes is to monitor currents from identical ion-chambers. Practical considerations require sophiscated and reliable circuitry. An AECL system developed for the Gentilly Reactor is described. (auth)

12168 (NAA-SR-11911) STATIC CONTROL OF SNAP REACTORS. Birney, K. R.; McGoff, D. J. (Atomics International, Canoga Park, Calif.). 30 May 1966. Contract AT(11-1)-GEN-8. 63p. Dep. NTIS $5.25.

Declassified 17 Apr 1973.

The control of a nuclear reactor in space presents problems for any mechanical system which may be used, especially for the long lifetimes (3 to 5 years) being considered. The concept of static control (no moving parts after a short active control period) has been investigated to determine the feasibility of this method of control. Since reliability of the power source for any space application is of the utmost importance, static control allows a high reliability by eliminating the control system failure probability. The selection of a reactor temperature-time profile and the uncertainties associated with maintaining it during operation are estimated. For a given power range a prepoison may be selected to supply the required reactivity gain. Hydrogen leakage, which is strongly temperature dependent, serves to damp the swing in reactor temperature with time. The nominal design considered is for a 50°F maximum temperature swing during the operating life under static control. A potentially attractive design approach would be to design and prepoison the reactor for operation under static control and employ an active control system. This mode of operation would minimize the consequences of a failure in the mechanical control system and decrease the temperature swing established for static control operation. Such a system would have the capability of following load requirements and, during its active lifetime, would not be limited to nearly constant power operation. It is concluded that the use of static control for the control of SNAP reactors appears to be an attractive mode of operation at core outlet temperatures up to 1300°F with improved hydrogen leakage barriers. The barrier material used for SNAP 10A and SNAP 8 Experimental Reactor (S8ER) is suitable at core outlet temperatures up to 1200°F and the hydrogen barrier for SNAP 8 Developmental System (S8DS) has met the acceptance test requirements at 1400°F, isothermal. Long-term endurance tests (out of core, isothermal) indicate that hydrogen leakage is sufficiently low that static control is feasible at 1300°F outlet temperature for lifetimes up to 2 years and power levels approaching 300 thermal kilowatts. (auth)

Reactor Licensing and Regulation

12169 (DOCKET-50003-178) INDIAN POINT STATION, UNIT 1. Petition for Full-Term Operating License, Amendment 5. (Consolidated Edison Co. of New York, Inc., New York). 15 Jun 1973. 95p. Dep. NTIS $6.75.

Requested information on certain structural questions, the fire protection and containment spray systems, and the quality assurance program at the Indian Point Station, Unit 1, is presented. (JWR)

12170 (DOCKET-50003-179) INDIAN POINT STATION, UNIT 1. Technical Specifications, Change 51. (Directorate of Licensing (AEC), Washington, D. C.). 30 May 1973. 3p. Dep. NTIS $3.00.

All containment ventilation valves must be closed during reactor operation to maintain the integrity of the containment except when venting is necessary to control changes in containment gage pressure due to changes in normal heat loads and atmospheric pressures. (FS)

12171 (DOCKET-50003-180) INDIAN POINT STATION, UNIT 1. Technical Specifications, Change 52. (Directorate of Licensing (AEC), Washington, D. C.). 18 May 1973. 11p. Dep. NTIS $3.00.

Changes are made permitting Region 7 fuel loading, limiting control rod insertion, and reducing average core height. (FS)

12172 (DOCKET-50003-181) INDIAN POINT STATION, UNIT 1. Technical Specifications, Change 50, Amendment 4. (Directorate of Licensing (AEC), Washington, D. C.). 23 May 1973. 13p. Dep. NTIS $3.00.

The Technical Specifications concerning reporting requirements are revised. (FS)

12173 (DOCKET-50003-182) INDIAN POINT STATION, UNIT 1. Safety Evaluation by the Directorate of Licensing. (Directorate of Licensing (AEC), Washington, D. C.). 11 Jun 1973. 7p. Dep. NTIS $3.00.

Improvements in the plant protection system including circuits for isolating containment, and for protection against steam line breaks are requested to provide additional protection for health and safety. (FS)

12174 (DOCKET-50010-163) DRESDEN NUCLEAR POWER STATION, UNIT 1. Hazards Summary Report, Proposed Modification 73-2. (Commonwealth Edison Co., Chicago, Ill.). 16 May 1973. 77p. Dep. NTIS $6.00.

Information on the fuel quality assurance program for the Dresden Nuclear Power Station, Unit 1, is presented. (JWR)

12175 (DOCKET-50010-171) DRESDEN NUCLEAR POWER STATION, UNIT 1. Diesel Fire Pump Inoperable. (Commonwealth Edison Co., Morris, Ill. (USA)). 12 Jun 1973. 2p. Dep. NTIS $3.00.

12176 (DOCKET-50010-172) DRESDEN NUCLEAR POWER STATION, UNIT 1. Technical Specifications, Change 25. Dresden Nuclear Power Station, Unit 2. Technical Specifications, Change 20. Dresden Nuclear Power Station, Unit 3. Technical Specifications, Change 11. (Directorate of Licensing (AEC), Washington, D. C.). 14 May 1973. 5p. (DOCKET-50237-342; DOCKET-50249-235). Dep. NTIS $3.00.

The protection factor for full facepiece respirators is changed from 500 to no more than 100. (FS)

12177 (DOCKET-50010-175) DRESDEN NUCLEAR POWER STATION, UNIT 1. License DPR-2, Section J.5.b.2 of Appendix "A," Power Range Monitoring Instrumentation. (Commonwealth Edison Co., Chicago, Ill.). 25 Jun 1973. 2p. Dep. NTIS $3.00.

The trip setting of 140% reactor power was found in the reactor power range monitor instrumentation. The setting should have been 120 ± 3% reactor power. (FS)

12178 (DOCKET-50010-176) DRESDEN NUCLEAR POWER STATION, UNIT 1. Setpoint Drift Problem on Channel 5 High Neutron Flux Sensor. (Commonwealth Edison Co., Morris, Ill. (USA)). 21 Jun 1973. 2p. Dep. NTIS $3.00.

12179 (DOCKET-50016-195) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Technical Specifications, Request for a Change. (Power Reactor Development Co., Detroit, Mich.). 14 Jun 1973. 7p. Dep. NTIS $3.00.

Request is made for changes in the specifications for testing and surveillance of the primary shield tank, the fuel transport facility, and the transfer tank. The changes are requested in the interest of economy in plant retirement. (FS)

12180 (DOCKET-50016-196) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Technical Specifications, Change 38.

(Directorate of Licensing (AEC), Washington, D. C.). 31 May 1973. 5p. Dep. NTIS $3.00.

Requirements for maintenance and testing the reactor building containment during reactor retirement are deleted. (FS)

12181 (DOCKET-50029-250) YANKEE NUCLEAR POWER STATION. Proposed Change No. 109. (Yankee Atomic Electric Co., Westboro, Mass.). 11 May 1973. 2p. Dep. NTIS $3.00.

Changes are requested in the reactor protection system to disconnect the permissive relay pressure switches from the turbine first stage pressure sensing line, and to reconnect the No. 1 nozzle pressure line which serves as a source of nozzle pressure indication. (FS)

12182 (DOCKET-50029-251) YANKEE NUCLEAR POWER STATION. Reactor Scram and Turbine Trip May 23, 1973. (Yankee Atomic Electric Co., Westboro, Mass.). 23 May 1973. 3p. Dep. NTIS $3.00.

12183 (DOCKET-50029-257) YANKEE NUCLEAR POWER STATION. Technical Specifications, Change 101. (Directorate of Licensing (AEC), Washington, D. C.). 23 May 1973. 14p. Dep. NTIS $3.00.

Changes were made in plant reporting requirements, for operation summaries, power generation, shutdowns, maintenance, radioactive effluent releases, solid wastes, environmental monitoring and abnormal occurrences. (FS)

12184 (DOCKET-50029-258) YANKEE NUCLEAR POWER STATION. Authorization of Interim Method and Administrative Control for Operation. (Directorate of Licensing (AEC), Washington, D. C.). 24 May 1973. 2p. Dep. NTIS $3.00.

12185 (DOCKET-50133-120) HUMBOLDT BAY POWER PLANT, Unit 3. NELIA Policy No. NF-113, Endorsement No. 61. (Pacific Gas and Electric Co., San Francisco, Calif.). 16 May 1973. 2p. Dep. NTIS $3.00.

12186 (DOCKET-50171-124) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Technical Specifications, Change 17. (Directorate of Licensing (AEC), Washington, D. C.). 3 May 1973. 2p. Dep. NTIS $3.00.

Request for deferment of biennial inspection of steam generators and steam relief valves is granted. (FS)

12187 (DOCKET-50171-125) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Inspection Report No. 50-171/73-01. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 16 May 1973. 15p. Dep. NTIS $3.00.

12188 (DOCKET-50206-203) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Draft Environmental Statement, Comments of Department of Transportation, U. S. Coast Guard. (Department of Transportation, Washington, D.C.). 30 May 1973. 1p. Dep. NTIS $3.00.

12189 (DOCKET-50206-204) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Technical Specifications, Change 9. (Directorate of Licensing (AEC), Washington, D. C.). 5 Jun 1973. 13p. Dep. NTIS $3.00.

Changes incorporating a new section on reporting requirements in the Technical Specifications and deleting reporting requirements from the Provisional Operating License are proposed. (FS)

12190 (DOCKET-50213-194) HADDAM NECK PLANT, UNIT 1. Cooperative Program of Monitoring Between State of Connecticut and Atomic Energy Commission. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 27 Feb 1973. 2p. Dep. NTIS $3.00.

12191 (DOCKET-50213-202) HADDAM NECK PLANT, UNIT 1. Draft Environmental Statement, Comments of Federal Power Commission. (Federal Power Commission, Washington, D. C. Bureau of Power). 11 Jun 1972. 3p. Dep. NTIS $3.00.

12192 (DOCKET-50213-205) HADDAM NECK PLANT. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Mar 1973. 232p. Dep. NTIS $13.75.

12193 (DOCKET-50213-206) HADDAM NECK PLANT, UNIT 1. Technical Specifications, Change 21. (Directorate of Licensing (AEC), Washington, D. C.). 14 Jun 1973. 13p. Dep. NTIS $3.00.

Revisions are given for the reporting requirements section of the Technical Specifications. (FS)

12194 (DOCKET-50213-209) HADDAM NECK PLANT, UNIT 1. Draft Environmental Statement, Comments of United States Department of the Interior. (Connecticut Yankee Atomic Power Co., Hartford). 19 Jun 1973. 6p. Dep. NTIS $3.00.

12195 (DOCKET-50219-268) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Main Steam Isolation Valve. (Jersey Central Power and Light Co., Morristown, N. J.). 5 Jun 1973. 1p. Dep. NTIS $3.00.

12196 (DOCKET-50219-269) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Drywell Head Manhole Cover. (Jersey Central Power and Light Co., Morristown, N. J.). 5 Jun 1973. 2p. Dep. NTIS $3.00.

12197 (DOCKET-50219-270) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Technical Specifications, Change 14. (Directorate of Licensing (AEC), Washington, D. C.). 22 May 1973. 11p. Dep. NTIS $3.00.

The reporting requirements of the Technical Specifications appended to the Provisional Operating License are completely revised. (FS)

12198 (DOCKET-50219-271) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Technical Specifications, Change 15. (Directorate of Licensing (AEC), Washington, D. C.). 25 May 1973. 16p. Dep. NTIS $3.00.

A request was approved to use XN-1 Critical Heat Flux Correlation to determine the safety limits of operation if a modification to include a limit on axial × radial peaking factor was applied. Operation with the Cycle 31 core was also approved. (FS)

12199 (DOCKET-50220-140) NINE MILE POINT NUCLEAR STATION, UNIT 1. Technical Specifications, Change Request. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 7 Jun 1973. 28p. Dep. NTIS $3.50.

12200 (DOCKET-50220-141) NINE MILE POINT NUCLEAR STATION, UNIT 1. Environmental Report, Supplement 3. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 25 May 1973. 7p. Dep. NTIS $3.00.

12201 (DOCKET-50220-143) NINE MILE POINT NUCLEAR STATION, UNIT 1. Provisional Operating License, Amendment 3. (Directorate of Licensing (AEC), Washington, D. C.). 12 Jun 1973. 5p. Dep. NTIS $3.00.

Amendment 3 changes the name of Nine Mile Point Nuclear Station to Unit No. 1 of the Nine Mile Point Nuclear Station. (FS)

12202 (DOCKET-50220-144) NINE MILE POINT NUCLEAR STATION, UNIT 1. Proposed Off-Gas System Acceptable. (Directorate of Licensing (AEC), Washington, D. C.). 3 May 1973. 1p. Dep. NTIS $3.00.

12203 (DOCKET-50237-333) DRESDEN NUCLEAR POWER STATION, UNIT 2. Dresden Station Report No. 28, Analyses and Procedures for Handling General Electric IF-300 Spent Fuel Shipping Cask. (Commonwealth Edison Co., Chicago, Ill.). 31 May 1973. 170p. Dep. NTIS $10.50.

12204 (DOCKET-50237-338) DRESDEN NUCLEAR POWER STATION, UNIT 2. Valve Found with Thermal Overload Tripped. (Commonwealth Edison Co., Morris, Ill. (USA)). 7 Jun 1973. 2p. Dep. NTIS $3.00.

12205 (DOCKET-50237-340) DRESDEN NUCLEAR POWER STATION, UNIT 2. Activity in Surge Tank Above Technical Specifications Limit April 5, 1973. (Commonwealth Edison Co., Morris, Ill. (USA)). 5 Apr 1973. 1p. Dep. NTIS $3.00.

12206 (DOCKET-50237-341) DRESDEN NUCLEAR POWER STATION, UNIT 2. Trip of MO-2-1301-1 Breaker on April 5, 1973. (Commonwealth Edison Co., Morris, Ill. (USA)). 5 Apr 1973. 1p. Dep. NTIS $3.00.

12207 (DOCKET-50237-343) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Steps Taken to Correct Items of Noncompliance Brought to Attention in Letter Dated March 27, 1973. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 27 Mar 1973. 50p. (DOCKET-50249-236). Dep. NTIS $4.50.

12208 (DOCKET-50237-344) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Main Steam Relief and Safety Valve Analyses. (Commonwealth Edison Co., Chicago, Ill.). 22 Jun 1973. 34p. (DOCKET-50249-237). Dep. NTIS $3.75.

12209 (DOCKET-50237-345) DRESDEN NUCLEAR POWER STATION, UNIT 2. Technical Specifications, Low Vacuum Scram Bypass Switches Drifted. (Commonwealth Edison Co., Chicago, Ill.). 22 Jun 1973. 4p. Dep. NTIS $3.00.

12210 (DOCKET-50237-346) DRESDEN NUCLEAR POWER STATION, UNIT 2. Isolation Condenser Valve 1301-1 Found Inoperable. (Commonwealth Edison Co., Chicago, Ill.). 15 Jun 1973. 2p. Dep. NTIS $3.00.

12211 (DOCKET-50244-156) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Armor Stone Addition to Ginna Breakwall. (Rochester Gas and Electric Corp., N. Y.). 15 May 1973. 4p. Dep. NTIS $3.00.

12212 (DOCKET-50244-165) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Draft Environmental Statement, Comments of Department of Transportation, U. S. Coast Guard. (Department of Transportation, Washington, D. C.). Jun 1973. 1p. Dep. NTIS $3.00.

12213 (DOCKET-50244-170) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Technical Specifications, Proposed Change 10. (Rochester Gas and Electric Corp., N. Y.). 12 Jun 1973. 10p. Dep. NTIS $3.00.

Conditions for reactor operation and specification changes and corresponding changes to the bases for the specifications are made for fuel densification. (FS)

12214 (DOCKET-50244-173) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Malfunction of Blend System Valve FCV-110B. (Rochester Gas and Electric Corp., N. Y.). 21 Jun 1973. 2p. Dep. NTIS $3.00.

12215 (DOCKET-50244-174) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrences 73-3 and 73-4: Failure of I-C Safety Injection Pump. (Rochester Gas and Electric Corp., N. Y.). 21 Jun 1973. 2p. Dep. NTIS $3.00.

12216 (DOCKET-50244-175) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. High High Bistable Setting Higher Than Specified Value; Safety Injection Pump Failed to Start Manually; Repeat of Previous Failure to Start. (Rochester Gas and Electric Corp., N. Y.). 7 Jul 1973. 5p. Dep. NTIS $3.00.

12217 (DOCKET-50244-176) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Discovery of Incorrect Value for High High Steam Flow Bistable Trip Setpoint. (Rochester Gas and Electric Corp., N. Y.). 18 Jun 1973. 2p. Dep. NTIS $3.00.

12218 (DOCKET-50244-177) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Monthly Report of Activity Measurements. (Rochester Gas and Electric Corp., N. Y.). 18 Jun 1973. 2p. Dep. NTIS $3.00.

12219 (DOCKET-50245-223) MILLSTONE NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Environmental Report, Addendum 5. (Millstone Point Co., Hartford, Conn.). 18 May 1973. 228p. (DOCKET-50336-58; DOCKET-50423-15). Dep. NTIS $13.50.

12220 (DOCKET-50245-231) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Inspection Report No. 50-245/73-10. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 25 May 1973. 16p. Dep. NTIS $3.00.

12221 (DOCKET-50247-120) INDIAN POINT NUCLEAR GENERATING UNIT 2. Technical Specifications, Change 1. (Directorate of Licensing (AEC), Washington, D. C.). 16 May 1973. 5p. Dep. NTIS $3.00.

An authorization is granted for Indian Point-2 operation, for testing purposes, at reactor core power levels not in excess of 50% of the rated power. (FS)

12222 (DOCKET-50249-222) DRESDEN NUCLEAR POWER STATION, UNIT 3. Special Report No. 26, Startup Test Report. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Dec 1972. 251p. (NEDC-10692). Dep. NTIS $14.75.

12223 (DOCKET-50249-231) DRESDEN NUCLEAR POWER STATION, UNIT 3. Isolation Condenser High Condensate Flow Switch Out of Calibration. (Commonwealth Edison Co., Morris, Ill. (USA)). 21 May 1973. 3p. Dep. NTIS $3.00.

12224 (DOCKET-50249-232) DRESDEN NUCLEAR POWER STATION, UNIT 3. Reactor Low Pressure Switch Out of Calibration. (Commonwealth Edison Co., Morris, Ill. (USA)). 25 May 1973. 3p. Dep. NTIS $3.00.

12225 (DOCKET-50249-233) DRESDEN NUCLEAR POWER STATION, UNIT 3. Steam Supply Valve Failed to Open. (Commonwealth Edison Co., Morris, Ill. (USA)). 9 Jun 1973. 2p. Dep. NTIS $3.00.

12226 (DOCKET-50250-127) TURKEY POINT PLANT, UNITS 3 AND 4. NELIA Policy No. NF-185, Endorsement No. 20. (Florida Power and Light Co.). 27 Apr 1973. 2p. (DOCKET-50251-109). Dep. NTIS $3.00.

12227 (DOCKET-50250-129) TURKEY POINT PLANT, UNITS 3 AND 4. Environmental Technical Specifications, Request for Authorization of Changes. (Florida Power and Light Co.). 4 May 1973. 5p. (DOCKET-50251-111). Dep. NTIS $3.00.

Minor corrections and a change in the frequency for making the required measurements on the discharged water are requested for the Environmental Technical Specifications of Appendix B of the Facility Operating License. (FS)

12228 (DOCKET-50250-132) TURKEY POINT PLANT, UNITS 3 AND 4. Program for Assessment of Impacts from Turbidity in Discharged Cooling Water. (Florida Power and Light Co.). 9 May 1973. 3p. (DOCKET-50251-116). Dep. NTIS $3.00.

12229 (DOCKET-50250-133) TURKEY POINT PLANT, UNITS 3 AND 4. Review of Control Circuits of Safety Related Equipment. (Florida Power and Light Co.). 30 May 1973. 1p. (DOCKET-50251-121). Dep. NTIS $3.00.

12230 (DOCKET-50250-134) TURKEY POINT PLANT, UNITS 3 AND 4. Mutual Atomic Energy Liability Underwriters' Policy MF-55, Endorsements 10, 11, 12, and 13. (Florida Power and Light Co.). 6 Jun 1973. 5p. (DOCKET-50251-122). Dep. NTIS $3.00.

12231 (DOCKET-50251-110) TURKEY POINT PLANT, UNIT 4. Indemnity Agreement No. B-46, Amendment 5. (Directorate of Licensing (AEC), Washington, D. C.). 23 Apr 1973. 2p. Dep. NTIS $3.00.

12232 (DOCKET-50251-112) TURKEY POINT PLANT, UNIT 4. Request for Clarification of Facility Operating License. (Florida Power and Light Co.). 4 May 1973. 2p. Dep. NTIS $3.00.

12233 (DOCKET-50251-117) TURKEY POINT PLANT, UNIT 4. AO-4-73-4, Generic Failure of Primary System Check Valves. (Florida Power and Light Co.). 18 May 1973. 2p. Dep. NTIS $3.00.

12234 (DOCKET-50251-118) TURKEY POINT PLANT, UNIT 4. Steps Taken to Correct Items in Violation of AEC Requirements Brought to Attention in Letter Dated March 12, 1973. (Florida Power and Light Co.). 2 Apr 1973. 24p. Dep. NTIS $3.25.

12235 (DOCKET-50251-119) TURKEY POINT PLANT, UNIT 4. Inspection Report No. 50-251/73-2. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 23 May 1973. 54p. Dep. NTIS $4.75.

12236 (DOCKET-50251-120) TURKEY POINT PLANT, UNIT 4. Inspection Report No. 50-251/73-3. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 10 May 1973. 17p. Dep. NTIS $3.00.

12237 (DOCKET-50251-125) TURKEY POINT PLANT, UNIT 4. Modifications to Heat Exchangers. (Florida Power and Light Co.). 16 May 1973. 3p. Dep. NTIS $3.00.

12238 (DOCKET-50254-204) QUAD-CITIES STATION, UNITS 1 AND 2. No State Effluent Limitations. (Commonwealth Edison Co., Chicago, Ill.). 27 Mar 1973. 1p. (DOCKET-50265-196). Dep. NTIS $3.00.

12239 (DOCKET-50254-205) QUAD-CITIES STATION, UNITS 1 AND 2. Safety Analysis Report, Revision to Proposed Modification 73-1. (Commonwealth Edison Co., Chicago, Ill.). 16 May 1973. 2p. (DOCKET-50265-197). Dep. NTIS $3.00.

12240 (DOCKET-50254-207) QUAD-CITIES STATION, UNIT 1. Technical Specifications, Request for Waiver of Limit on Chlorine in Discharge Bay. (Commonwealth Edison Co., Chicago, Ill.). 5 Jun 1973. 5p. (DOCKET-50265-199). Dep. NTIS $3.00.

12241 (DOCKET-50254-208) QUAD-CITIES STATION, UNITS 1 AND 2. Dresden Nuclear Power Station, Units 1, 2, and 3. Zion Station Nuclear Power Plant, Units 1 and 2. Overcurrent Trip Delay Device in Circuit Breakers in Engineered Safety Systems. (Commonwealth Edison Co., Chicago, Ill.). 11 Apr 1973. 2p. (DOCKET-50265-204; DOCKET-50010-173; DOCKET-50237-339; DOCKET-50249-234; DOCKET-50295-128; DOCKET-50304-100). Dep. NTIS $3.00.

12242 (DOCKET-50254-210) QUAD-CITIES STATION, UNITS 1 AND 2. Technical Specifications, Change 5. (Directorate of Licensing (AEC), Washington, D. C.). 4 May 1973. 31p. (DOCKET-50265-206). Dep. NTIS $3.75.

Changes concerning the Administrative Controls Section of the Technical Specifications appended to the Facility Operating License are approved. (FS)

12243 (DOCKET-50254) QUAD-CITIES STATION, UNITS 1 AND 2. Technical Specifications, Change 6. (Directorate of Licensing (AEC), Washington, D. C.). 17 May 1973. 6p. (DOCKET-50265-207). Dep. NTIS $3.00.

Information on a technical specifications change concerning inservice inspection requirements at the Quad-Cities Station, Units 1 and 2, is presented. (JWR)

12244 (DOCKET-50254-212) QUAD-CITIES STATION, UNITS 1 AND 2. Chlorine Residual Concentrations in Excess of Technical Specifications. (Commonwealth Edison Co., Cordova, Ill.). 14 Jun 1973. 2p. (DOCKET-50265-208). Dep. NTIS $3.00.

12245 (DOCKET-50254-216) QUAD-CITIES STATION, UNITS 1 AND 2. Modified Off-Gas System. (Commonwealth Edison Co., Chicago, Ill.). 13 Jun 1973. 1p. (DOCKET-50265-210). Dep. NTIS $3.00.

12246 (DOCKET-50255-158) PALISADES PLANT. Overexposure of Individual. (Consumers Power Co., Covert, Mich. (USA)). 5 Apr 1973. 6p. Dep. NTIS $3.00.

12247 (DOCKET-50255-161) PALISADES PLANT. AO-1-73, Failure of the Two Neutron Detector Start-up Channels; AO-2-73, Failure of One Main Steam Isolation Valve to Close. (Consumers Power Co., Jackson, Mich.). 29 May 1973. 2p. Dep. NTIS $3.00.

12248 (DOCKET-50255-162) PALISADES PLANT. Interim Special Technical Specifications, Proposed Change. (Consumers Power Co., Jackson, Mich.). 8 Jun 1973. 8p. Dep. NTIS $3.00.

12249 (DOCKET-50255-165) PALISADES PLANT. Reactor Noise Analysis. (Consumers Power Co., Jackson, Mich.). 12 Jun 1973. 3p. Dep. NTIS $3.00.

12250 (DOCKET-50255-166) PALISADES PLANT. Primary and Secondary Radioactivity Report, May 1973. (Consumers Power Co., Jackson, Mich.). 18 Jun 1973. 3p. Dep. NTIS $3.00.

12251 (DOCKET-50255-167) PALISADES PLANT. Nuclear Quality Assurance Policy Manual for Operation of Nuclear Power Plants. (Consumers Power Co., Jackson, Mich.). 19 Jun 1973. 40p. Dep. NTIS $4.00.

12252 (DOCKET-50259-94) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Fuel Densification Effects, NEDM-10735, Supplements Nos. 1 and 2 Referenced. (Tennessee Valley Authority, Chattanooga). 18 May 1973. 1p. (DOCKET-50260-86; DOCKET-50296-82). Dep. NTIS $3.00.

12253 (DOCKET-50259-95) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Environmental Radioactivity Levels, Semiannual Report, January-June 1972. Revised Pages 7 and 8. (Tennessee Valley Authority, Chattanooga). 18 May 1973. 3p. (DOCKET-50260-87; DOCKET-50296-83). Dep. NTIS $3.00.

12254 (DOCKET-50259-96) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Amendment 50. (Tennessee Valley Authority, Chattanooga). 30 May 1973. 517p. (DOCKET-50260-88; DOCKET-50296-84). Dep. NTIS $28.00.

The following information on the Browns Ferry Nuclear Power Station, Units 1, 2, and 3 is presented: additional information on the rod sequence control system; a description and safety analysis for the cooling tower installation; a description of the simultaneous startup for the two standby gas treatment system trains; revised proposed technical specifications; revised startup test program; revised startup test program; and miscellaneous additions to the Final Safety Analysis Report. (JWR)

12255 (DOCKET-50259-97) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Inspection Report No. 50-259/73-5. (Directorate of Regulatory Operations (AEC), Atlanta, GA (USA). Region II). 8 May 1973. 21p. Dep. NTIS $3.25.

12256 (DOCKET-50259-98) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Effects of Fuel Densification. (Tennessee Valley Authority, Chattanooga). 21 Jun 1973. 1p. (DOCKET-50260-90; DOCKET-50296-85). Dep. NTIS $3.00.

12257 (DOCKET-50259-99) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Equipment Failures. (Tennessee Valley Authority, Chattanooga). 6 Jun 1973. 10p. Dep. NTIS $3.00.

12258 (DOCKET-50259-100) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Increased Liability Insurance. (Mutual Atomic Energy Liability Underwriters, New York (USA)). 19 Jun 1973. 4p. Dep. NTIS $3.00.

12259 (DOCKET-50261-179) H. B. ROBINSON UNIT 2. Refueling Outage. (Carolina Power and Light Co., Raleigh, N. C.). 25 May 1973. 12p. Dep. NTIS $3.00.

12260 (DOCKET-50261-180) H. B. ROBINSON UNIT 2. Steps Taken to Correct Violations of Technical Specifications Brought to Attention in Letter Dated March 16, 1973. (Carolina Power and Light Co., Raleigh, N. C.). 2 Apr 1973. 37p. Dep. NTIS $4.00.

12261 (DOCKET-50261-181) H. B. ROBINSON UNIT 2. Request for 94% Thermal Power Authorization. (Carolina Power and Light Co., Raleigh, N. C.). 4 Jun 1973. 1p. Dep. NTIS $3.00.

12262 (DOCKET-50261-182) H. B. ROBINSON UNIT 2. Draft Environmental Statement, Comments of Office of Assistant Secretary of Commerce. (Department of Commerce, Washington, D. C.). 5 Jun 1973. 3p. Dep. NTIS $3.00.

12263 (DOCKET-50261-184) H. B. ROBINSON UNIT 2. Monthly Report of Primary and Secondary Activity Measurements and Effluent Discharge Activity Levels. (Carolina Power and Light Co., Raleigh, N. C.). 4 Jun 1973. 2p. Dep. NTIS $3.00.

12264 (DOCKET-50261-186) H. B. ROBINSON UNIT 2. Vent Valves on Pressure Sensing Line Open. (Carolina Power and Light Co., Hartsville, S. C. (USA)). 6 Jun 1973. 2p. Dep. NTIS $3.00.

12265 (DOCKET-50261-187) H. B. ROBINSON UNIT 2. Draft Environmental Statement, Comments of South Carolina Pollution Control Authority. (South Carolina Pollution Control Authority, Columbia (USA)). 8 Jun 1973. 3p. Dep. NTIS $3.00.

12266 (DOCKET-50261-191) H. B. ROBINSON UNIT 2. License DPR-23, Determination of Shutdown Margin. (Carolina Power and Light Co., Raleigh, N. C.). 13 Jun 1973. 2p. Dep. NTIS $3.00.

12267 (DOCKET-50261-192) H. B. ROBINSON UNIT 2. Request for 100% Thermal Power Authorization. (Carolina Power and Light Co., Raleigh, N. C.). 13 Jun 1973. 5p. Dep. NTIS $3.00.

12268 (DOCKET-50261-193) H. B. ROBINSON UNIT 2. Abnormal Occurrence Report: Open Vent Valves. (Carolina Power and Light Co., Raleigh, N. C.). 14 Jun 1973. 2p. Dep. NTIS $3.00.

12269 (DOCKET-50261-194) H. B. ROBINSON UNIT 2. Technical Specifications, Request for Revision. (Carolina Power and Light Co., Raleigh, N. C.). 15 Jun 1973. 4p. Dep. NTIS $3.00.

Changes are requested concerning surveillance requirements of systems undergoing maintenance which prevents performance of the test or when plant conditions cause the test to be impossible or inappropriate. (FS)

12270 (DOCKET-50261-195) H. B. ROBINSON UNIT 2. Environmental Statement, Comments of Federal Power Commission. (Federal Power Commission, Washington, D. C. Bureau of Power). 21 Jun 1973. 3p. Dep. NTIS $3.00.

12271 (DOCKET-50261-196) H. B. ROBINSON UNIT 2. Request for 100% Thermal Power Authorization. (Carolina Power and Light Co., Raleigh, N. C.). 20 Jun 1973. 3p. Dep. NTIS $3.00.

12272 (DOCKET-50263-208) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. No. 11 Emergency Diesel Generator Failed to Start on May 5, 1973. High Pressure Coolant Injection System Isolated on High Steam Flow. (Northern States Power Co., Monticello, Minn. (USA)). 19 May 1973. 2p. Dep. NTIS $3.00.

12273 (DOCKET-50263-215) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Three Containment Isolation Valves Found to Leak, January 18, 1973; Torus Manway Cover Opened When Reactor Temperature Was 260°F, March 8, 1973; Line Fuses for Exhaust Fan Motors at Lower Rating Than Specified, March 31, 1973; Reactor Building-to-Torus Vacuum Breaker Valve Malfunction, May 17, 1973; Low Boron Concentration in Standby Liquid Control Storage Tank, May 23, 1973. (Northern States Power Co., Minneapolis, Minn.). 25 May 1973. 5p. Dep. NTIS $3.00.

12274 (DOCKET-50263-216) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Low Boron Concentration in Standby Liquid Control System. (Northern States Power Co., Minneapolis, Minn.). 4 Jun 1973. 2p. Dep. NTIS $3.00.

12275 (DOCKET-50263-217) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Technical Specifications, Change

Request Dated June 1, 1973. (Northern States Power Co., Minneapolis, Minn.). 1 Jun 1973. 17p. Dep. NTIS $3.00.

A change in transient analyses is requested which gives the most limiting conditions expected during the first 2,250 MWd/STU exposure increment of cycle two. (FS)

12276 (DOCKET-50263-218) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Semiannual Operating Report No. 4, Revised Pages. (Northern States Power Co., Minneapolis, Minn.). 6 Jun 1973. 30p. Dep. NTIS $3.50.

12277 (DOCKET-50263-220) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Malfunction of Relief Valve Bellows Leak Detection System Pressure Switches. (Northern States Power Co., Minneapolis, Minn.). 18 Jun 1973. 2p. Dep. NTIS $3.00.

12278 (DOCKET-50273-221) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Technical Specifications, Change Request Dated June 1, 1973. (Northern States Power Co., Minneapolis, Minn.). 20 Jun 1973. 4p. Dep. NTIS $3.00.

A change is requested from transient resulting from closure of all main steamline isolation valves to transient following a turbine trip without bypass. (FS)

12279 (DOCKET-50266-110) POINT BEACH NUCLEAR PLANT, UNIT 1. Technical Specification Change 4. (Directorate of Licensing (AEC), Washington, D. C.). 22 May 1973. 30p. Dep. NTIS $3.50.

Information on a technical specifications change concerning the power rating and exposure time during cycle 2 at the Point Beach Nuclear Plant, Unit 1, is presented. (JWR)

12280 (DOCKET-50266-111) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Inspection Reports Nos. 050-266/73-06 and 050-301/73-04. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 4 May 1973. 17p. (DOCKET-50301-97). Dep. NTIS $3.00.

12281 (DOCKET-50266-113) POINT BEACH NUCLEAR PLANT, UNIT 1. Personnel Exposure Data. (Wisconsin Electric Power Co., Milwaukee). 15 May 1973. 1p. Dep. NTIS $3.00.

12282 (DOCKET-50266-114) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Unscheduled Release of Radioactivity. (Wisconsin Electric Power Co., Milwaukee). 28 May 1973. (DOCKET-50301-98). Dep. NTIS $3.00.

12283 (DOCKET-50267-64) FORT ST. VRAIN NUCLEAR GENERATING STATION. Final Safety Analysis Report, Amendment 27. (Public Service Co. of Colorado, Denver). 11 May 1973. 49p. Dep. NTIS $4.50.

Revised and requested information on the engineered safety features and site characteristics at the Fort St. Vrain Nuclear Generating Station is presented. (JWR)

12284 (DOCKET-50267-66) FORT ST. VRAIN NUCLEAR GENERATING STATION. Cooperative Program of Effluent and Environmental Monitoring. (Directorate of Regulatory Operations (AEC), Denver, Colo. Region IV). 1 Jun 1973. 2p. Dep. NTIS $3.00.

12285 (DOCKET-50269-114) OCONEE NUCLEAR STATION, UNIT 1. Additional Cooling Water During Loss of Coolant Accident. (Duke Power Co., Charlotte, N. C.). 1 Feb 1973. 1p. Dept. NTIS $3.00.

12286 (DOCKET-50269-115) OCONEE NUCLEAR STATION, UNIT 1. Reactor Building Spray Pumps Inoperable During Reactor Operation. (Duke Power Co., Charlotte, N. C.). 18 May 1973. 4p. Dep. NTIS $3.00.

12287 (DOCKET-50269-116) OCONEE NUCLEAR STATION, UNIT 1. Request for Change in Technical Specifications. (Duke Power Co., Charlotte, N. C.). 30 May 1973. 1p. Dep. NTIS $3.00.

Revised specifications to provide appropriate limits for fuel densification effects are requested. (FS)

12288 (DOCKET-50269-117) OCONEE NUCLEAR STATION, UNIT 1. Technical Specifications, Change 3. (Directorate of Licensing (AEC), Washington, D. C.). 6 Jun 1973. 38p. Dep. NTIS $4.00.

Information on technical specification changes made to compensate for possible fuel densification effects at the Oconee Nuclear Station, Unit 1, is presented. (JWR)

12289 (DOCKET-50271-173) VERMONT YANKEE NUCLEAR POWER STATION. Ecological Studies of the Connecticut River, Vernon, Vermont. (Aquatec, Inc., South Burlington, VT. (USA)). 1973. 333p. Dep. NTIS $18.75.

For Vermont Yankee Nuclear Power Corp., Rutland.

12290 (DOCKET-50271-181) VERMONT YANKEE NUCLEAR POWER STATION. Inspection Report No. 50-271/73-05. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 27 Apr. 1973. 6p. Dep. NTIS $3.00.

12291 (DOCKET-50271-182) VERMONT YANKEE NUCLEAR POWER STATION. AO-73-13, Mechanical Trip Mechanism in Breaker Undependable; AO-73-14, Valves Failed to Close Fully During Group III Isolation. (Vermont Yankee Nuclear Power Corp., Rutland). 31 May 1973. 3p. Dep. NTIS $3.00.

12292 (DOCKET-50271-183) VERMONT YANKEE NUCLEAR POWER STATION. Request for Changes in Technical Specifications. (Vermont Yankee Nuclear Power Corp., Rutland). 23 May 1973. 11p. Dep. NTIS $3.00.

Changes in the Technical Specification are requested, which include revised pages and revised definitions for Abnormal Occurrences. (FS)

12293 (DOCKET-50271-184) VERMONT YANKEE NUCLEAR POWER STATION. Containment Air Dilution System. (Vermont Yankee Nuclear Power Corp., Rutland). 4 Jun 1973. 4p. Dep. NTIS $3.00.

12294 (DOCKET-50271-185) VERMONT YANKEE NUCLEAR POWER STATION. AO-73-14, Blown Fuse. (Vermont Yankee Nuclear Power Corp., Rutland). 6 Jun 1973. 2p. Dep. NTIS $3.00.

12295 (DOCKET-50271-186) VERMONT YANKEE NUCLEAR POWER STATION. Technical Specifications, Change 9. (Directorate of Licensing (AEC), Washington, D. C.). 11 Jun 1973. 12p. Dep. NTIS $3.00.

Changes are made concerning plant reporting requirements. (FS)

12296 (DOCKET-50271-187) VERMONT YANKEE NUCLEAR POWER STATION. Technical Specifications, Change 8. (Directorate of Licensing (AEC), Washington, D. C.). 3 May 1973. 4p. Dep. NTIS $3.00.

Staff positions filled by personnel holding Senior Operator and Operator licenses are indicated, and minimum shift crew personnel and license requirements are given. (FS)

12297 (DOCKET-50271-188) VERMONT YANKEE NUCLEAR POWER STATION. Technical Specifications, Proposed Change 12. (Vermont Yankee Nuclear Power Corp., Rutland). 30 May 1973. 37p. Dep. NTIS $4.00.

Information on proposed changes to technical specifications concerning operation of the Vermont Yankee Nuclear Power Station is presented. (JWR)

12298 (DOCKET-50271-189) VERMONT YANKEE NUCLEAR POWER STATION. AO-73-15, First Stage Turbine Pressure Permissive Pressure Switch Failed to Actuate at Proper Setpoint; AO-73-16, Lightning Struck Top of Plant Ventilation Stack; AO-73-17, Drywell Purging and Vent Exhaust Valve Failed to Shut. (Vermont Yankee Nuclear Power Corp., Rutland). 22 Jun 1973. 10p. Dep. NTIS $3.00.

12299 (DOCKET-50271-190) VERMONT YANKEE NUCLEAR POWER STATION. Operation Report No. 73-04 for April 1973. (Vermont Yankee Nuclear Power Corp., Rutland). 14 Jun 1973. 29p. Dep. NTIS $3.50.

12300 (DOCKET-50271-191) VERMONT YANKEE NUCLEAR POWER STATION. Operation Report No. 73-05 for May 1973. (Vermont Yankee Nuclear Power Corp., Rutland). 14 Jun 1973. 26p. Dep. NTIS $3.50.

12301 (DOCKET-50272-66) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 22. (Public Service Electric and Gas Co., Newark, N. J.). 21 May 1973. 323p. (DOCKET-50311-65). Dep. NTIS $18.25.

Revised and requested information on the research and development requirements, environmental radiation monitoring, containment system, operations aspects, personnel, and safety analysis of the Salem Nuclear Generating Station, Units 1 and 2, is presented. (JWR)

12302 (DOCKET-50272-67) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Action Taken to Correct Items of Violation Brought to Attention Following Inspection on January 31, 1973 and February 1 and 2, 1973. (Public Service Electric and Gas Co., Newark, N. J.). 3 Apr 1973. 26p. (DOCKET-50311-66). Dep. NTIS $3.50.

12303 (DOCKET-50272-68) SALEM NUCLEAR GENERATING STATION, UNIT 1. Water Quality Certification by Delaware River Basin Commission. (Delaware River Basin Commission, Trenton, N. J. (USA)). 21 May 1973. 1p. Dep. NTIS $3.00.

12304 (DOCKET-50272-69) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Fuel Densification Effect, Additional Information. (Public Service Electric and Gas Co., Newark, N. J). 9 Jan 1973. 2p. (DOCKET-50311-67). Dep. NTIS $3.00.

12305 (DOCKET-50272-70) SALEM NUCLEAR GENERATING STATION, UNIT 1. Delaware River Basin Commission Action Dated October 29, 1971 Was Not Intended as a Water Quality Certification. (Delaware River Basin Commission, Trenton, N. J. (USA)). 8 May 1973. 1p. Dep. NTIS $3.00.

12306 (DOCKET-50272-71) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. No. 11 and 12 Containment Spray Pumps, No. 13 Component Cooling Pump; No. 11, 12, 13, and 14 Reactor Coolant Pumps, Modification to Volute Nozzles. (Public Service Electric and Gas Co., Newark, N. J.). 29 May 1973. 6p. (DOCKET-50311-68). Dep. NTIS $3.00.

12307 (DOCKET-50272-72) SALEM NUCLEAR GENERATING STATION, UNIT 1. Reactor Coolant Pump Internals; No. 11 Residual Heat Removal Heat Exchanger, Construction Site Inflicted Damage. (Public Service Electric and Gas Co., Newark, N. J.). 25 May 1973. 6p. Dep. NTIS $3.00.

12308 (DOCKET-50275-45) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Marine Environment in the Vicinity of Diablo Cove with Special Reference to Abalones and Bony Fish. (Pacific Gas and Electric Co., San Francisco, Calif.). 13 Jun 1973. 438p. (DOCKET-50323-44). Dep. NTIS $24.00.

12309 (DOCKET-50275-46) DIABLO CANYON NUCLEAR POWER PLANT, UNIT 1. Thermoplastic Insulation Repaired. (Pacific Gas and Electric Co., San Francisco, Calif.). 31 May 1973. 3p. Dep. NTIS $3.00.

12310 (DOCKET-50277-93) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. AEC DRO I Letter Dated April 12, 1973 and Report 50-277/73-03; AEC DRO I Letter Dated April 12, 1973 and Report 50-278/73-01. (Philadelphia Electric Co., Pa.). 21 May 1973. 2p. Dep. NTIS $3.00.

12311 (DOCKET-50277-94) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Inspection Report 50-277/73-08. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 3 May 1973. 13p. Dep. NTIS $3.00.

12312 (DOCKET-50277-95) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Inspection Report No. 50-277/73-09. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 21 May 1973. 10p. Dep. NTIS $3.00.

12313 (DOCKET-50277-96) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Inspection Report No. 50-277/73-12. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 9 May 1973. 10p. Dep. NTIS $3.00.

12314 (DOCKET-50277-97) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Final Safety Analysis Report, Amendment 27. (Philadelphia Electric Co., Pa.). 22 May 1973. 38p. (DOCKET-50278-86). Dep. NTIS $3.00.

Revisions relate to additional information concerning main steam line restraint design and the effects of a postulated break in a high-energy fluid-carrying pipe outside of the containment. (FS)

12315 (DOCKET-50277-98) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Safety Evaluation, Supplement 2. (Directorate of Licensing (AEC), Washington, D. C.). 23 May 1973. 18p. (Docket 50278-87). Dep. NTIS $3.00.

Supplement 2 updates the Safety Evaluation Report concerning the control rod drop accident, radioactive waste system, anticipated transients without scrams, postulated ruptures in high energy fluid pipes outside the primary containment and fuel densification. (FS)

12316 (DOCKET-50277-99) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Inspection Report No. 50-277/73-13. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 18 May 1973. 15p. Dep. NTIS $3.00.

12317 (DOCKET-50277-100) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Comments on ACRS Review. (Philadelphia Electric Co., Pa.). 31 May 1973. 2p. (DOCKET-50278-88). Dep. NTIS $3.00.

The four areas discussed in the ACRS letter of 9/21/73 are: the analysis of control rod drop accidents, control of combustible gas concentrations, failure to scram during transients, and reactor vessel integrity. The first three are described in supplement 1 of the FSAR and the fourth item is under study. (FS)

12318 (DOCKET-50277-101) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Final Safety Analysis Report, Amendment 28. (Philadelphia Electric Co., Pa.). 15 Jun 1973. 82p. (DOCKET-50278-89). Dep. NTIS $6.25.

The amendment contains revisions for the environmental specifications, the quality assurance program and miscellaneous corrections. (FS)

12319 (DOCKET-50280-139) SURRY POWER STATION, UNIT 1. Request for Extension of Time for Submittal of Report. (Virginia Electric and Power Co., Richmond). 6 Feb 1973. 2p. Dep. NTIS $3.00.

12320 (DOCKET-50280-140) SURRY POWER STATION, UNIT 1. AO-S1-72-09, Additional Information. (Virginia Electric and Power Co., Richmond). 23 May 1973. 2p. Dep. NTIS $3.00.

12321 (DOCKET-50280-141) SURRY POWER STATION, UNITS 1 AND 2. Technical Specifications, Proposed Change 8. (Virginia Electric and Power Co., Richmond). 4 Jun 1973. 56p. (DOCKET-50281-111). Dep. NTIS $5.00.

Information on proposed technical specifications changes due to fuel densification uncertainties at the Surry Power Station, Units 1 and 2, is presented. The changes concern in-core surveillance, power levels, and the 100-hour full power performance test. (JWR)

12322 (DOCKET-50280-142) SURRY POWER STATION, UNITS 1 AND 2. Incore Surveillance Program. (Virginia Electric and Power Co., Richmond). 5 Jun 1973. 1p. (DOCKET-50281-112). Dep. NTIS $3.00.

12323 (DOCKET-50280-143) SURRY POWER STATION, UNIT 1. Steps Taken to Correct the Items in Violation of AEC Requirements Brought to Attention in Letter Dated April 19, 1973. (Virginia Electric and Power Co., Richmond). 9 May 1973. 25p. $3.25.

12324 (DOCKET-50280-144) SURRY POWER STATION, UNITS 1 AND 2. Steps Taken to Correct Items in Violation with AEC Requirements Brought to Attention in Letter Dated March 23, 1973. (Virginia Electric and Power Co., Richmond). 9 Apr 1973. 37p. (DOCKET-50281-113). Dep. NTIS $4.00.

12325 (DOCKET-50280-145) SURRY POWER STATION, UNIT 1. AO-S1-73-07, Failure of Main Steam Line Valve to Close; Failure of Feedwater Check Valve. (Virginia Electric and Power Co., Richmond). 8 Jun 1973. 12p. Dep. NTIS $3.00.

12326 (DOCKET-50280-146) SURRY POWER STATION, UNIT 1. Authority to Utilize North Anna Unit 1 Coolant Pump Motor and Flywheel as Replacement. (Directorate of Licensing (AEC), Washington, D. C.). 11 Jun 1973. 7p. Dep. NTIS $3.00.

12327 (DOCKET-50281-105) SURRY POWER STATION, UNIT 2. Structural Acceptance Test, Concrete Primary Reactor Containment. (Stone and Webster Engineering Corp., Boston, Mass.). 11 May 1973. 174p. Dep. NTIS $10.75.

For Virginia Electric and Power Co.

12328 (DOCKET-50281-114) SURRY POWER STATION, UNIT 2. Failure of Motor-Operated Valve to Open and to Close. (Virginia Electric and Power Co., Richmond). 21 Jun 1973. 2p. Dep. NTIS $3.00.

12329 (DOCKET-50282-118) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Environmental Report. (Directorate of Licensing (AEC), Washington, D. C.). May 1973. 434p. (DOCKET-50306-111). Dep. NTIS $23.75.

The environmental effects of construction and operation of the Prairie Island Nuclear Generating Plant, Units 1 and 2, are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plant operation. (JWR)

12330 (DOCKET-50282-122) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Fuel Densification Effects. (Northern States Power Co., Minneapolis, Minn.). 8 Jan 1973. 1p. (DOCKET-50306-113). Dep. NTIS $3.00.

12331 (DOCKET-50282-123) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Safety Evaluation, Supplement 3. (Directorate of Licensing (AEC). Washington, D. C.). 31 May 1973. 74p. (DOCKET-50306-114). Dep. NTIS $5.75.

The causes and effects of uranium oxide fuel pellet densification are reviewed and fuel densification effects on Prairie Island-1 Reactor are evaluated. (FS)

12332 (DOCKET-50282-124) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Review of Control Circuits. (Northern States Power Co., Minneapolis, Minn.). 5 Jun 1973. 1p. (DOCKET-50306-115). Dep. NTIS $3.00.

12333 (DOCKET-50285-95) FORT CALHOUN STATION, UNIT 1. Facility Operating License, Technical Specifications, and Environmental Technical Specifications. (Omaha Public Power District, Nebr.). 24 May 1973. 234p. Dep. NTIS $13.75.

12334 (DOCKET-50285-96) FORT CALHOUN STATION, UNIT 1. Indemnity Agreement No. B-67, Amendment 1. (Omaha Public Power District, Nebr.). 25 May 1973. 3p. Dep. NTIS $3.00.

12335 (DOCKET-50285-97) FORT CALHOUN STATION, UNIT 1. Inspection Report No. 50-285/73-07. (Directorate of Regulatory Operations (AEC), Denver, Colo. Region IV). 11 May 1973. 13p. Dep. NTIS $3.00.

12336 (DOCKET-50285-98) FORT CALHOUN STATION, UNIT 1. High Power Trip/ΔT Circuit. (Omaha Public Power District, NEBR). 26 Jun 1973. 2p. Dep. NTIS $3.00.

A request is made to incorporate a circuit to auctioneer the higher of two signals for high flux or high thermal power in the high power trip. The circuit provides a redundant set of sensors for high power trip and will be modified to allow bypass at low power operation. (FS)

12337 (DOCKET-50286-82) INDIAN POINT NUCLEAR GENERATING UNIT 3. Application for Licenses, Amended and Substituted. (Consolidated Edison Co. of New York, Inc., New York). 18 May 1973. 60p. Dep. NTIS $5.00.

12338 (DOCKET-50286-83) INDIAN POINT NUCLEAR GENERATING UNIT 3. Final Facility Description and Safety Analysis Report, Supplement 11. (Consolidated Edison Co. of New York, Inc., New York). 31 Jan 1973. 99p. Dep. NTIS $7.00.

Requested information on the engineered safety features, electrical system, initial test program, and miscellaneous other items at the Indian Point Nuclear Generating Unit 3 is presented. (JWR)

12339 (DOCKET-50286-84) INDIAN POINT NUCLEAR GENERATING UNIT 3. Analysis of High Energy Lines. (Consolidated Edison Co. of New York, Inc., New York). 14 May 1973. 48p. Dep. NTIS $4.50.

The results of an analysis of the effects of postulated high energy pipe breaks outside containment at the Indian Point Nuclear Generating Unit 3 are presented. (JWR)

12340 (DOCKET-50286-85) INDIAN POINT NUCLEAR GENERATING UNIT 3. Environmental Report, Supplements Nos. 4 and 5, Comments of U. S. Department of the Interior. (Department of the Interior, Washington, D. C. (USA)). 10 May 1973. 1p. Dep. NTIS $3.00.

12341 (DOCKET-50286-86) INDIAN POINT NUCLEAR GENERATING UNIT 3. Action Taken to Correct Items of Violation Brought to Attention Following Inspection on November 20, 21, 22; December 1 and December 14, 1972. (Consolidated Edison Co. of New York, Inc., New York). 7 Feb 1973. 38p. Dep. NTIS $4.00.

12342 (DOCKET-50286-87) INDIAN POINT NUCLEAR GENERATING UNIT 3. Modifications to be Incorporated into Residual Heat Removal System. (Consolidated Edison Co. of New York, Inc., New York). 25 May 1973. 2p. Dep. NTIS $3.00.

12343 (DOCKET-50286-88) INDIAN POINT NUCLEAR GENERATING UNIT 3. Final Facility Description and Safety Analysis Report, Supplement 19. (Consolidated Edison Co. of New York, Inc., New York). Jun 1973. 120p. Dep. NTIS $8.00.

Revised and additional information on the Indian Point Nuclear Generating Unit 3 is presented for the following: cooling system; control system; containment; electrical system; auxiliary systems; safety analysis; technical specifications; and personnel. (JWR)

12344 (DOCKET-50287-83) OCONEE NUCLEAR STATION, UNIT 3. Inspection Report No. 50-287/73-1. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 19 Jun 1973. 16p. Dep. NTIS $3.00.

12345 (DOCKET-50289-102) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Review of Control Circuits of Safety Related Equipment. (Metropolitan Edison Co., Reading, Pa.). 21 May 1973. 7p. Dep. NTIS $3.00.

12346 (DOCKET-50289-104) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. River Water Intake House Silting. (Metropolitan Edison Co., Reading, Pa.). 11 Jun 1973. 2p. Dep. NTIS $3.00.

12347 (DOCKET-50293-145) PILGRIM NUCLEAR POWER STATION. AO-73-17, Differential Pressure Indicating Switches Not Operating Properly. (Boston Edison Co., Mass.). 1 Jun 1973. 2p. Dep. NTIS $3.00.

12348 (DOCKET-50295-120) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Final Environmental Statement, Comments of National Audubon Society, Central Midwest Region. (National Audubon Society, Owensboro, KY. (USA). Central Midwest Regional Office). 15 May 1973. 5p. (DOCKET-50304-97). Dep. NTIS $3.00.

12349 (DOCKET-50295-121) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Loss of High Voltage Power to Source Range Monitors While Reactor Was Shutdown, Drawing on Second Page. (Commonwealth Edison Co., Zion, Ill. (USA)). 4 May 1973. 2p. (DOCKET-50304-98). Dep. NTIS $3.00.

12350 (DOCKET-50295-125) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Discharge of Boric Acid. (Commonwealth Edison Co., Zion, Ill. (USA)). 29 May 1973. 5p. Dep. NTIS $3.00.

12351 (DOCKET-50295-126) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Containment Liner Incident. (Commonwealth Edison Co., Chicago. Ill.). 1 Jun 1973. 39p. Dep. NTIS $4.00.

12352 (DOCKET-50295-129) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Inspection Reports 050-295/73-21 AND 050-304/73-06. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 1 Jun 1973. 7p. (DOCKET-50304-101). Dep. NTIS $3.00.

12353 (DOCKET-50295-130) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Inspection Report 050-295/73-23. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 30 May 1973. 12p. Dep. NTIS $3.00.

12354 (DOCKET-50295-131) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Final Report Concerning Deflections Found in the Containment Liner. (Commonwealth Edison Co., Chicago, Ill.). 14 Jun 1973. 57p. Dep. NTIS $5.00.

12355 (DOCKET-50295-132) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Failure of Safety Injection Pump 1A. (Commonwealth Edison Co., Zion, ILL. (USA)). 8 Jun 1973. 1p. Dep. NTIS $3.00.

12356 (DOCKET-50295-133) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Safety Injection Signal Occurred. (Commonwealth Edison Co., Zion, ILL. (USA)). 18 Jun 1973. 2p. Dep. NTIS $3.00.

12357 (DOCKET-50295-134) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Special Report No. 1, Main Steam Line Check Valve Modifications, Supplement A. (Commonwealth Edison Co., Chicago, ILL). 21 Jun 1973. 79p. (DOCKET-50304-102). Dep. NTIS $6.00.

12358 (DOCKET-50295-135) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Coolant System Overpressurization. (Commonwealth Edison Co., Chicago, ILL). 22 Jun 1973. 2p. Dep. NTIS $3.00.

12359 (DOCKET-50295-136) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Proposed Design for Intake Structure. (Commonwealth Edison Co., Chicago, ILL). 26 Jun 1973. 20p. (DOCKET-50304-103). Dep. NTIS $3.00.

12360 (DOCKET-50298-80) COOPER NUCLEAR STATION. Final Safety Analysis Report, Amendment 22. (Nebraska Public Power District, Columbus). 10 May 1973. 250p. Dep. NTIS $14.50.

Revised and additional information concerning the safety related technical specifications for the Cooper Nuclear Station is presented. (JWR)

12361 (DOCKET-50305-82) KEWAUNEE NUCLEAR POWER PLANT. Final Safety Analysis Report, Amendment 29. (Wisconsin Public Service Corp., Green Bay). 15 May 1973. 37p. Dep. NTIS $4.00.

Additional information relevant to the analysis postulated rup-

tures of high energy fluid lines inside of containment for the Kewaunee Nuclear Power Plant is presented. (JWR)

12362 (DOCKET-50305-85) KEWAUNEE NUCLEAR POWER PLANT. Review of Control Circuit Designs. (Wisconsin Public Service Corp., Green Bay). 1 Jun 1973. 2p. Dep. NTIS $3.00.

12363 (DOCKET-50305-86) KEWAUNEE NUCLEAR POWER PLANT. Inspection Report No. 050-305/73-07. (Directorate of Regulatory Operations (AEC), Glen Ellyn, ILL. Region III). 6 Jun 1973. 6p. Dep. NTIS $3.00.

12364 (DOCKET-50309-115) MAINE YANKEE ATOMIC POWER STATION. Measurement of Intake Velocity. (Maine Yankee Atomic Power Co., Westboro, Mass.). 31 May 1973. 19p. Dep. NTIS $3.00.

12365 (DOCKET-50309-116) MAINE YANKEE ATOMIC POWER STATION. Monthly Report 4-73, April 1973. (Maine Yankee Atomic Power Co., Westboro, Mass.). 8 Jun 1973. 26p. Dep. NTIS $3.50.

12366 (DOCKET-50312-77) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Meteorological Data Collection System. (Sacramento Municipal Utility District, Calif.). 31 May 1973. 4p. Dep. NTIS $3.00.

12367 (DOCKET-50312-78) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Final Safety Analysis Report, Amendment 22. (Sacramento Municipal Utility District, Calif.). 4 Jun 1973. 245p. Dep. NTIS $14.25.

Revised information on the reactor protection systems, electrical system, and technical specifications for the Rancho Seco Nuclear Generating Station, Unit 1, is presented. (JWR)

12368 (DOCKET-50313-83) ARKANSAS NUCLEAR ONE, UNIT 1. Order Extending Completion Date to January 1, 1974. (Directorate of Licensing (AEC), Washington, D. C.). 4 Jun 1973. 3p. Dep. NTIS $3.00.

12369 (DOCKET-50315-119) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Benton Harbor Power Plant Limnological Studies. Part XIII. Cook Plant Preoperational Studies, 1972. (Michigan Univ., Ann Arbor. Great Lakes Research Div). Mar 1973 285p. (Docket-50316-118). Dep. NTIS $16.25.

For American Electric Power Service Corp., New York, NY and Indiana and Michigan Electric Co., New York, NY.

12370 (DOCKET-50315-123) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 42. (Indiana and Michigan Power Co., New York: Indiana and Michigan Electric Co., New York). 22 May 1973. 45p. (Docket-50316-120). Dep. NTIS $4.25.

12371 (DOCKET-50315-124) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Treatment of Steam Generator Blowdown Vapor. (American Electric Power Service Corp., New York). 25 May 1973. 11p. (DOCKET-50316-121). Dep. NTIS $3.00.

12372 (DOCKET-50315-125) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 44. (Westinghouse Electric Corp., Pittsburgh, Pa. PWR Systems Div.). 4 Jun 1973. 185p. (DOCKET-50316-122). Dep. NTIS $11.25.

For Indiana and Michigan Power Co., New York, NY and Indiana and Michigan Electric Co., New York, NY.

Additional Information on the Donald C. Cook Nuclear Plant, Units 1 and 2, is presented in the following areas: analysis of consequences of postulated high-energy pipe ruptures outside of containment; analysis of jet forces inside the containment due to postulated ruptures; and miscellaneous revisions to the Final Safety Analysis Report. (JWR)

12373 (DOCKET-50320-50) THREE MILE ISLAND NUCLEAR STATION, UNIT 2. Water in Reactor Pressure Vessel. Metropolitan Edison Co., Reading, PA). 11 Jun 1973. 3p. Dep. NTIS $3.00.

12374 (DOCKET-50321-82) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 11 May 1973. 255p. Dep. NTIS $14.75.

Information on the Edwin I. Hatch Nuclear Plant, Unit 1, is presented under the following main headings: site characteristics; design of structures, components, equipment and systems; reactor design; cooling system; engineered safety features; instrumentation and controls; electric power system; auxiliary systems; steam and power conversion system; radioactive waste management; radiation protection; operations aspects; test program; accident analysis; technical specifications; quality assurance; and financial and legal aspects. (JWR)

12375 (DOCKET-50321-83) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Final Safety Analysis Report, Amendment 34. (Georgia Power Co., Atlanta). 1 Jun 1973. 62p. Dep. NTIS $5.25.

Additional information on the reactor physics, electrical system, safety analysis, emergency planning, and quality assurance program at the Edwin I. Hatch Nuclear Plant, Unit 1, is presented. (JWR)

12376 (DOCKET-50323-41) DIABLO CANYON NUCLEAR POWER PLANT, UNIT 2. Steps Taken to Correct Items Brought to Attention in Letter Dated April 2, 1973. (Pacific Gas and Electric Co., San Francisco, Calif.). 25 Apr 1973. 25p. Dep. NTIS $3.25.

Information concerning the fabrication and quality control for steam generator safety valves for the Diablo Canyon Nuclear Power Plant, Unit 2, is presented. (JWR)

12377 (DOCKET-50323-42) DIABLO CANYON NUCLEAR POWER PLANT, UNIT 2. Inspection Report No. 050-0323/73-01. (Directorate of Regulatory Operations (AEC), Berkeley, Calif. (USA). Region V). 2 May 1973. 12p. Dep. NTIS $3.00.

12378 (DOCKET-50323-43) DIABLO CANYON NUCLEAR POWER PLANT, UNIT 2. Steps Taken to Correct Items Brought to Attention in Letter Dated March 22, 1973. (Pacific Gas and Electric Co., San Francisco, Calif.). 25 Apr 1973. 19p. Dep. NTIS $3.00.

Information concerning the quality assurance requirements for the fabrication of pipe spools for the Diablo Canyon Nuclear Power Plant, Unit 2, is presented. (JWR)

12379 (DOCKET-50324-81) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 18. (Carolina Power and Light Co., Raleigh, N. C.). 21 May 1973. 337p. (Docket-50325-82). Dep. NTIS $19.00.

Revised and requested information on the radiological monitoring program, reactor cooling system, personnel, emergency planning, testing, technical specifications, and safety analysis at the Brunswick Steam Electric Plant, Units 1 and 2, is presented. (JWR)

12380 (DOCKET-50324-82) BRUNSWICK STEAM ELECTRIC PLANT, UNIT 1. Inspection Report No. 50-324/73-3. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 22 May 1973. 26p. Dep. NTIS $3.50.

12381 (DOCKET-50324-83) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D.C.). Jun 1973. 264p. (DOCKET-50325-83). Dep. NTIS $15.25.

12382 (DOCKET-50331-99) DUANE ARNOLD ENERGY CENTER. Inspection Report No. 050-331/73-04. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 7 May 1973. 16p. Dep. NTIS $3.00.

12383 (DOCKET-50331-100) DUANE ARNOLD ENERGY CENTER. Steps Taken to Correct Items of Noncompliance Brought to Attention in Letter Dated April 6, 1973. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 29 May 1973. 24p. Dep. NTIS $3.25.

12384 (DOCKET-50331-101) DUANE ARNOLD ENERGY CENTER. Inspection Report No. 050-331/73-06. (Directorate of Regulatory Operations (AEC), Glen Ellyn, ILL. Region III). 4 Jun 1973. 17p. Dep. NTIS $3.00.

12385 (DOCKET-50333-93) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Final Safety Analysis Report. Supplement 20. (Power Authority of the State of New York). 14 May 1973. 279p. Dep. NTIS $16.00.

Revised and requested information on the James A. FitzPatrick Nuclear Power Plant is presented for the following subjects: cooling system; instrumentation; control system; electrical system; auxiliary systems; power conversion system; radioactive waste disposal; safety analysis; quality assurance; and emergency planning. (JWR)

12386 (DOCKET-50333-97) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Final Environmental Statement, Comments of United States Environmental Protection Agency. (Environmental Protection Agency, New York (USA)). 25 May 1973. 3p. Dep. NTIS $3.00.

12387 (DOCKET-50333-98) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Water Certification, New York State Department of Environmental Conservation. (New York State Dept. of Environmental Conservation, Albany, N. Y.). 1 Jun 1973. 2p. Dep. NTIS $3.00.

12388 (DOCKET-50334-67) BEAVER VALLEY POWER STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Pittsburgh Area Office of the Department of Housing and Urban Development. (Department of Housing and Urban Development, Pittsburgh, PA. (USA). Pittsburgh Area Office). 9 May 1973. 2p. (DOCKET-50412-10). Dep. NTIS $3.00.

12389 (DOCKET-50334-68) BEAVER VALLEY POWER STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Pennsylvania State Agencies. (Pennsylvania Office of State Planning and Development, Harrisburg (USA)). 14 May 1973. 9p. (Docket-50412-11). Dep. NTIS $3.00.

12390 (DOCKET-50334-70) BEAVER VALLEY POWER STATION, UNIT 1. Draft Environmental Statement, Comments of Pennsylvania Department of Environmental Resources. (Pennsylvania Office of State Planning and Development, Harrisburg (USA)). 21 May 1973. 9p. Dep. NTIS $3.00.

12391 (DOCKET-50334-71) BEAVER VALLEY POWER STATION, UNIT 1. Inspection Report No. 50-334/73-04. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 3 May 1973. 9p. Dep. NTIS $3.00.

12392 (DOCKET-50334-72) BEAVER VALLEY POWER STATION, UNIT 1. Draft Environmental Statement, Comments of United States Department of the Interior. (Department of the Interior, Washington, D. C. (USA)). 1 Jun 1973. 6p. Dep. NTIS $3.00.

12393 (DOCKET-50334-73) BEAVER VALLEY POWER STATION, UNIT 1. Draft Environmental Statement, Comments of Advisory Council on Historic Preservation. (Advisory Council on Historic Preservation, Washington, D. C. (USA)). 31 May 1973. 2p. Dep. NTIS $3.00.

12394 (DOCKET-50334-74) BEAVER VALLEY POWER STATION, UNIT 1. Action Taken to Correct the Items of Violation Brought to Attention Following Inspection on February 13-15, 1973. (Duquesne Light Co., Pittsburgh, PA). 3 May 1973. 40p. Dep. NTIS $4.00.

12395 (DOCKET-50334-75) BEAVER VALLEY POWER STATION, UNIT 1. Environmental Radioactivity Monitoring Program, Alleged Violations. (Duquesne Light Co., Pittsburgh, PA). 2 May 1973. 40p. Dep. NTIS $4.00.

12396 (DOCKET-50334-76) BEAVER VALLEY POWER STATION, UNIT 1. Reactor Vessel Nozzle Safe-End Repair. (Duquesne Light Co., Pittsburgh, PA). 13 Jun 1973. 2p. Dep. NTIS $3.00.

12397 (DOCKET-50334-77) BEAVER VALLEY POWER STATION, UNITS 1 AND 2. Comments on Draft Environmental Impact Statements. (Duquesne Light Co., Pittsburgh, PA). 25 Jun 1973. 7p. (DOCKET-50412-20). Dep. NTIS $3.00.

12398 (DOCKET-50334-78) BEAVER VALLEY POWER STATION, UNITS 1 AND 2. AEC Draft Environmental Statement. (Duquesne Light Co., Pittsburgh, PA). 25 Jun 1973. 3p. (DOCKET-50412-21). Dep. NTIS $3.00.

12399 (DOCKET-50335-58) ST. LUCIE PLANT, UNIT 1. Cadwelds Will Be Used for Splicing Reinforcing Bars. (Florida Power and Light Co.). 22 May 1973. 1p. Dep. NTIS $3.00.

12400 (DOCKET-50335-59) ST. LUCIE PLANT, UNIT 1. Inspection Report No. 50-335/73-3. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 24 May 1973. 18p. Dep. NTIS $3.00.

12401 (DOCKET-50335-60) ST. LUCIE PLANT, UNIT 1. Valve Wall Thickness. (Florida Power and Light Co.). 23 May 1973. 4p. Dep. NTIS $3.00.

12402 (DOCKET-50335-61) ST. LUCIE PLANT, UNIT 1. Environmental Report, Supplement 9. (Florida Power and Light Co.). 5 Jun 1973. 19p. Dep. NTIS $3.00.

12403 (DOCKET-50335-62) ST. LUCIE PLANT, UNIT 1. Inspection Report No. 50-335/73-4. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 31 May 1973. 13p. Dep. NTIS $3.00.

12404 (DOCKET-50335-63) ST. LUCIE PLANT, UNIT 1. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jun 1973. 284p. Dep. NTIS $16.25.

The environmental effects of construction and operation of the St. Lucie Power Reactor Unit 1 are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plant operation. (DCC)

12405 (DOCKET-50335-64) ST. LUCIE PLANT, UNIT 1. Reactor Coolant Piping Incident Report. (Florida Power and Light Co.). 30 May 1973. 5p. Dep. NTIS $3.00.

12406 (DOCKET-50336-62) MILLSTONE NUCLEAR POWER STATION, UNIT 2. Action to be Taken to Correct Items of Noncompliance Brought to Attention Following Inspection on February 21-22, 1973. (Millstone Point Co., Hartford, Conn.). 9 Apr 1973. 15p. Dep. NTIS $3.00.

12407 (DOCKET-50336-63) MILLSTONE NUCLEAR POWER STATION, UNIT 2. Reporting of Deficiencies in Design and Construction. (Millstone Point Co., Hartford, Conn.). 12 Jun 1973. 4p. Dep. NTIS $3.00.

Analysis of the reactor core support barrel is presented after on-site off-loading from a shipping barge in which an overload of the barrel may have occurred due to an unbalanced lift. (FS)

12408 (DOCKET-50338-72) NORTH ANNA POWER STATION, UNITS 1 AND 2. Notice of Receipt of Application for Facility Operating Licenses; Notice of Consideration of Issuance of Facility Operating Licenses and Notice of Opportunity for Hearing. (Directorate of Licensing (AEC), Washington, D. C.). 18 May 1973. 9p. (Docket-50339-71). Dep. NTIS $3.00.

12409 (DOCKET-50338-74) NORTH ANNA POWER STATION, UNITS 1 AND 2. Steps Taken to Correct Items in Violation of AEC requirements Brought to Attention in Letter Dated April 30, 1973. (Virginia Electric and Power Co., Richmond). 14 May 1973. 29p. Dep. NTIS $3.50.

12410 (DOCKET-50338-75) NORTH ANNA POWER STATION, UNITS 1 AND 2. Final Safety Analysis Report, Supplement Volume 1. (Virginia Electric and Power Co., Richmond). 11 Jun 1973. 320p. (Docket-50339-72). Dep. NTIS $18.00.

Revised and additional information on the North Anna Power Station, Units 1 and 2, is presented under the following main headings: site; design criteria; reactor; reactor coolant; engineered safeguards; instrumentation and controls; electrical systems; auxiliary systems; steam and power conversion systems; radioactive waste management; radiation protection; initial tests and operation; accident analysis; technical specifications; and quality assurance. (JWR)

12411 (DOCKET-50338-76) NORTH ANNA POWER STATION, UNITS 1 AND 2. Applicant's Environmental Report Supplement, Appendix K; License Application, Amendment 17. (Virginia Electric and Power Co., Richmond). 30 Apr 1973. 237p. (DOCKET-50339-74). Dep. NTIS $14.00.

12412 (DOCKET-50339-73) NORTH ANNA POWER STATION, UNIT 2. Inspection Report No. 50-339/73-2. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 3 May 1973. 20p. Dep. NTIS $3.00.

12413 (DOCKET-50341-59) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Steps Taken as Result of Vendor Inspection Audit Report No. 999-020/73-01. (Detroit Edison Co., Mich). 16 Apr 1973. 3p. Dep. NTIS $3.00.

12414 (DOCKET-50341-61) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Notice of Violation Regarding Pipe Fabrication at Dravo. (Detroit Edison Co., Mich.). 23 May 1973. 15p. Dep. NTIS $3.00.

12415 (DOCKET-50346-60) DAVIS-BESSE NUCLEAR POWER STATION. Final Safety Analysis Report, Revision 1. (Toledo Edison Co., Ohio). 8 Jun 1973. 387 p. Dep. NTIS $21.50.

Revised information on the Davis-Besse Nuclear Power Station is presented under the following headings: site; buildings and equipment; reactor cooling systems; containment system; instrumentation and control; auxiliary systems; electrical system; power conversion system; waste disposal; radiation protection; operations aspects; and accident analysis. (JWR)

12416 (DOCKET-50348-61) JOSEPH M. FARLEY NUCLEAR PLANT, UNIT 1. Reactor Upper Internals Fire. (Alabama Power Co., Birmingham). 1 Jun 1973. 4p. Dep. NTIS $3.00.

12417 (DOCKET-50352-36) LIMERICK GENERATING STATION, UNITS 1 AND 2. Pasturing Dairy Cows in Montgomery County. (Pennsylvania State Univ., Morristown (USA). Coopera-

tive Extension Service). 22 May 1973. 1p. (DOCKET-50353-36). Dep. NTIS $3.00.

12418 (DOCKET-50352-38) LIMERICK GENERATING STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 14. (Philadelphia Electric Co., PA). 25 May 1973. 36p. (DOCKET-50353-38). Dep. NTIS $4.00.

12419 (DOCKET-50352-40) LIMERICK GENERATING STATION, UNITS 1 AND 2. Applicant's Environmental Report, Supplement 4. (Philadelphia Electric Co., PA). Jun 1973. 22p. (DOCKET-50353-40). Dep. NTIS $3.25.

12420 (DOCKET-50354-41) NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNIT 1. Control of Potential Radioiodine Releases. (Public Service Electric and Gas Co., Newark, N. J.). 5 Jun 1973. 2p. (DOCKET-50355-40). Dep. NTIS $3.00.

12421 (DOCKET-50354-42) NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNITS 1 AND 2. Safety Evaluation, Supplement 1. (Directorate of Licensing (AEC), Washington, D. C.). 17 May 1973. 27p. (DOCKET-50355-41). Dep. NTIS $3.50.

12422 (DOCKET-50355-42) NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNIT 2. Vendor Inspection Report No. 999-035/73-03. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 13 Apr 1973. 10p. Dep. NTIS $3.00.

12423 (DOCKET-50361-43) SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3. Preliminary Safety Analysis Report, Amendment 18. (Southern California Edison Co., Rosemead, Calif.). 15 Jun 1973. 32p. (DOCKET-50362-42). Dep. NTIS $3.75.

The amendment provides revised information concerning site tsunami studies and several errata to the amended PSAR. (FS)

12424 (DOCKET-50368-42) ARKANSAS NUCLEAR ONE, UNIT 2. Steps Taken to Correct Items in Violation of AEC Requirements Brought to Attention in Letter Dated March 28, 1973. (Directorate of Regulatory Operations (AEC), Atlanta, GA (USA). Region II). 28 Mar 1973. 17p. Dep. NTIS $3.00.

12425 (DOCKET-50373-35) LA SALLE COUNTY STATION, UNITS 1 AND 2. Plans for Development of La Salle County Station Cooling Lake. (Commonwealth Edison Co., Chicago, Ill.). 23 May 1973. 2p. (DOCKET-50374-35). Dep. NTIS $3.00.

12426 (DOCKET-50373-36) LA SALLE COUNTY STATION, UNITS 1 AND 2. Proposed Cooling Lake as a Public Recreation Area. (Argonne National Lab., Ill.). 23 Apr 1973. 11p. (DOCKET-50374-36). Dep. NTIS $3.00.

12427 (DOCKET-50373-37) LA SALLE COUNTY STATION, UNITS 1 AND 2. Analysis of the La Salle Heat Dissipation System. (Argonne National Lab., Ill). 11 Apr 1973. 20p. (DOCKET-50374-37). Dep. NTIS $3.00.

12428 (DOCKET-50382-63) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Preliminary Safety Analysis Report, Amendment 36. (Louisiana Power and Light Co., New Orleans). 30 May 1973. 11p. Dep. NTIS $3.00.

Amendment No. 36 amends the Preliminary Safety Analysis Report by updating information on transportation accidents near the reactor site on the Mississippi River and by correcting minor errors in previously submitted information. (FS)

12429 (DOCKET-50382-64) WATERFORD STEAM ELECTRIC STATION, UNIT 3. List of Combustion Engineering Reports Applicable. (Louisiana Power and Light Co., New Orleans). 15 May 1973. 3p. Dep. NTIS $3.00.

12430 (DOCKET-50382-65) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Safety Evaluation, Supplement 1. (Directorate of Licensing (AEC), Washington, D. C.). 1 Jun 1973. 60p. Dep. NTIS $5.00.

This supplement considers unresolved items in the original Safety Evaluation including transportation and military facilities, foundation engineering, systems quality group classification, liquid waste management, containment functional design, auxiliary feedwater system, essential service water system, main steam system, gaseous waste, and main steam line rupture inside the containment. (FS)

12431 (DOCKET-50387-36) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Pennsylvania Office of State Planning and Development. (Pennsylvania Office of State Planning and Development, Harrisburg (USA)). 3 May 1973. 4p. (DOCKET-50388-35). Dep. NTIS $3.00.

12432 (DOCKET-50387-39) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of the United States Environmental Protection Agency. (Environmental Protection Agency, Washington, D. C. (USA)). 25 May 1973. 15p. (DOCKET-50388-38). Dep. NTIS $3.00.

12433 (DOCKET-50387-40) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jun 1973. 322p. (DOCKET-50388-39). Dep. NTIS $18.50.

12434 (DOCKET-50368-43) ARKANSAS NUCLEAR ONE, UNIT 2. Codes and Standards. (Arkansas Power and Light Co., Little Rock). 31 May 1973. 11p. Dep. NTIS $3.00.

Approval is requested for incorporating a list of ASME Section III Code Cases into the requirements of purchase orders for Arkansas-2 Reactor. (FS)

12435 (DOCKET-50389-18) ST. LUCIE PLANT, UNIT 2. Preliminary Safety Analysis Report, Antitrust Review Supplement. (Florida Power and Light Co.). 19 Apr 1973. 31p. Dep. NTIS $3.75.

12436 (DOCKET-50400-45) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. Dam and Dike Core Materials to Have a Plasticity Index of Not Less Than 10. (Carolina Power and Light Co., Raleigh, N. C.). 25 May 1973. 1p. (DOCKET-50401-45; DOCKET-50402-45; DOCKET-50403-45). Dep. NTIS $3.00.

12437 (DOCKET-50400-46) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. License Application, Amendment 26. (Carolina Power and Light Co., Raleigh, N.C.). 17 May 1973. 68p. (DOCKET-50401-46; DOCKET-50402-46; DOCKET-50403-46). Dep. NTIS $5.50.

Financial data on the owners of the Shearon Harris Power Reactor Units 1, 2, 3, and 4 are presented. Estimated costs for the power reactors are included. (DCC)

12438 (DOCKET-50409-53) LA CROSSE BOILING WATER REACTOR. Valve Wall Thickness. (Dairyland Power Cooperative, La Crosse, Wis.). 4 May 1973. 1p. Dep. NTIS $3.00.

12439 (DOCKET-50409-54) LA CROSSE BOILING WATER REACTOR. Supplement 1 to LACBWR Refueling Plan for Fuel Cycle II. (Dairyland Power Cooperative, La Crosse, Wis.). 8 Jun 1973. 21p. Dep. NTIS $3.25.

12440 (DOCKET-50409-55) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report. (Dairyland Power Cooperative, La Crosse, Wis.). Mar 1973. 25p. (DPC-851-57). Dep. NTIS $3.25.

12441 (DOCKET-50409-56) LA CROSSE BOILING WATER REACTOR. Technical Specifications, Change 11. (Directorate of Licensing (AEC), Washington, D. C.). 11 May 1973. 2p. Dep. NTIS $3.00.

A change requiring the protection factor for respirators to be reduced from 500 to no more than 100 is requested. Procedures for determining the protection factor for respirators are changed. (FS)

12442 (DOCKET-50409-57) LA CROSSE BOILING WATER REACTOR. Steps Taken to Correct Items of Noncompliance Brought to Attention in Letter Dated April 23, 1973. (Dairyland Power Cooperative, La Crosse, Wis.). 29 May 1973. 26p. Dep. NTIS $3.50.

12443 (DOCKET-50410-32) NINE MILE POINT NUCLEAR STATION, UNIT 2. Preliminary Safety Analysis Report, Supplement 11. (Niagara Mohawk Power Corp., Lycoming, N. Y.). 15 Jun 1973. 121p. Dep. NTIS $8.35.

Requested information on the Nine Mile Point Nuclear Station, Unit 2, is presented for the following subject areas: cooling system; containment system; instrumentation and control; electrical system; auxiliary systems; safety analysis; and quality assurance program. (JWR)

12444 (DOCKET-50410-33) NINE MILE POINT NUCLEAR STATION, UNIT 2. Draft Environmental Statement, Applicant's Responses to Additional Government Agency Comments. (Niagara Mohawk Power Corp., Syracuse, NY). 29 May 1973. 42p. Dep. NTIS $4.25.

12445 (DOCKET-50410-34) NINE MILE POINT NUCLEAR STATION, UNIT 2. Preliminary Safety Analysis Report, Information to Be Incorporated into an Amendment. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 21 May 1973. 12p. Dep. NTIS $3.00.

Plant design modifications and other information for the Prelim-

inary Safety Analysis Report are described for: process pipelines penetrating the primary containment, biological shield wall, maximum wetwell temperature, k factors for vacuum-breaker system piping and valves, exterior building walls and foundations, seismic design and qualification of structures, missile analysis, battery charger, and quality assurance personnel. (FS)

12446 (DOCKET-50410-35) NINE MILE POINT NUCLEAR STATION, UNIT 2. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jun 1973. 966p. Dep. NTIS $50.50.

12447 (DOCKET-50410-36) NINE MILE POINT NUCLEAR STATION, UNIT 2. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 15 Jun 1973. 259p. Dep. NTIS $15.00.

12448 (DOCKET-50412-18) BEAVER VALLEY POWER STATION, UNIT 2. Amendment 5. Preliminary Safety Analysis Report, Volume 11. (Duquesne Light Co., Pittsburgh, PA). 4 May 1973. 149p. Dep. NTIS $9.50.

Changes are made concerning charcoal filtration capacity, the supplementary leak collection and release system, post-DBA hydrogen control, charcoal filtration for iodine, charcoal filtration in the main steam valve area, cooling during intermediate hot shutdown, condenser water booster pumps, and auxiliary building ventilation. Questions on stress limits of ASME Class 2 and 3 components, failures in the protection system, wind speed and direction, faulted operation of components, protection system to actuate reactor trips, and radiation exposure of control room personnel are answered. (FS)

12449 (DOCKET-50412-19) BEAVER VALLEY POWER STATION, UNIT 2. Draft Environmental Statement, Comments of the U. S. Department of the Interior. (Department of the Interior, Washington, D. C. (USA)). 6 Jun 1973. 7p. Dep. NTIS $3.00.

12450 (DOCKET-50413-21) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, No Comments by Corps of Engineers. (Corps of Engineers, Charleston, S. C. (USA). Charleston District). 15 May 1973. 1p. (DOCKET-50414-21). Dep. NTIS $3.00.

12451 (DOCKET-50413-23) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of South Carolina Pollution Control Authority. (South Carolina Pollution Control Authority, Columbia (USA)). 8 Jun 1973. 3p. (DOCKET-50414-23). Dep. NTIS $3.00.

12452 (DOCKET-50413-26) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Duke Power Company. (Duke Power Co., Charlotte, N. C.). 8 Jun 1973. 44p. (DOCKET-50414-26). Dep. NTIS $4.25.

12453 (DOCKET-50416-27) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Federal Power Commission. (Federal Power Commission, Washington, D. C. Bureau of Power). 11 Jun 1973. 3p. (DOCKET-50417-27). Dep. NTIS $3.00.

12454 (DOCKET-50416-28) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 7. (Mississippi Power and Light Co., Jackson (USA)). 8 Jun 1973. 325p. (DOCKET-50417-28). Dep. NTIS $18.25.

Changes are made concerning chlorine shipment and storage, river traffic accidents, structure sharing, liquid line breaks, ECCS redundancy and testing, the protection system including the diesel and HPCS generators, spent fuel pool guard rails, demineralizers, circulation pumps, heat exchangers, fuel shipping casks, gantry, polar and cask cranes, standby service water, cooling towers, cooling system, chilled water system, service water, automatic CO_2 system, fire protection, liquid wastes, and containment ventilation. (FS)

12455 (DOCKET-50416-29) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Department of Transportation, U. S. Coast Guard. (Coast Guard, Baltimore, MD. Field Testing and Development Center). 5 Jun 1973. 35p. (DOCKET-50417-29). Dep. NTIS $3.75.

12456 (DOCKET-50416-32) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Applicant. (Mississippi Power and Light Co., Jackson (USA)). 4 Jun 1973. 2p. (DOCKET-50417-32). Dep. NTIS $3.00.

12457 (DOCKET-50424-15) ALVIN W. VOGTLE NUCLEAR PLANT, UNITS 1, 2, 3, AND 4. Draft Environmental Statement, Comments of United States Department of the Interior. (Department of the Interior, Washington, D. C. (USA)). 10 May 1973. 2p. (DOCKET-50425-15; DOCKET-50426-15; DOCKET-50427-15). Dep. NTIS $3.00.

12458 (DOCKET-50424-16) ALVIN W. VOGTLE NUCLEAR PLANT, UNITS 1, 2, 3, AND 4. Preliminary Safety Analysis Report, Amendment 2. (Georgia Power Co., Atlanta). 1 Jun 1973. 237p. (DOCKET-50425-16; DOCKET-50426-16; DOCKET-50427-16). Dep. NTIS $14.00.

Changes are given concerning seismic design, facility arrangement, area climate, flood history, ground water conditions, soil and foundation interactions, dewatering during excavation, wind and tornado loading, coolant pressure boundary leakage detection, new-fuel storage, emergency lighting, radioactivity in evacuation, and rod ejection accident analysis. (FS)

12459 (DOCKET-50434-3) SURRY POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Volume 2. (Virginia Electric and Power Co., Richmond). 1973. 347p. (DOCKET-50435-3). Dep. NTIS $19.50.

Information is presented concerning site geology and meteorology. (DCC)

12460 (DOCKET-50438-1) BELLEFONTE NUCLEAR PLANT, UNITS 1 AND 2. License Application. (Tennessee Valley Authority, Knoxville). 19 Jun 1973. 4p. (DOCKET-50439-1). Dep. NTIS $3.00.

12461 (DOCKET-50438-2) BELLEFONTE NUCLEAR PLANT, UNITS 1 AND 2. Information Pursuant to 10 CFR Section 50.33 of the Commission's Rules and Regulations. (Tennessee Valley Authority, Knoxville). 19 Jun 1973. 99p. (DOCKET-50439-2). Dep. NTIS $7.00.

The organization and financial qualifications of the TVA are discussed. A copy of Power Annual Report which discusses electricity and the environment is included. (FS)

12462 (DOCKET-50438-4) BELLEFONTE NUCLEAR PLANT, UNITS 1 AND 2. Draft Environmental Statement, Volume 2. (Tennessee Valley Authority, Knoxville). 19 Jun 1973. 294p. (DOCKET-50439-4). Dep. NTIS $16.75.

12463 (DOCKET-50438-5) BELLEFONTE NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 1. (Tennessee Valley Authority, Knoxville). 19 Jun 1973. 384p. (DOCKET-50439-5). Dep. NTIS $21.25.

This volume is concerned with a description of the facility; a comparison with similar facilities; fuel densification research and development; reactor vessel model flow tests; post irradiation examination program; and the geography, meteorology, and hydrology of the site. (FS)

12464 (DOCKET-50438-6) BELLEFONTE NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 2. (Tennessee Valley Authority, Knoxville). 19 Jun 1973. 395p. (DOCKET-50439-6). Dep. NTIS $21.75.

Information on the Bellefonte plant site hydrology, geology, and seismology is presented. (FS)

12465 (DOCKET-50438-7) BELLEFONTE NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 3. (Tennessee Valley Authority, Knoxville). 19 Jun 1973. 579p. (DOCKET-50439-7). Dep. NTIS $31.00.

This volume is concerned with the design of structures, components, and systems including seismic qualification, wind and tornado loadings, water level, missile protection, protection from pipe breaks, computer programs used in design, mechanical systems, environmental design of mechanical and electric equipment, and the mechanical, nuclear, and thermal hydraulic design of the reactor. (FS)

12466 (DOCKET-50438-9) BELLEFONTE NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 5. (Tennessee Valley Authority, Knoxville). 19 Jun 1973. 521p. (DOCKET-50439-9). Dep. NTIS $28.25.

The safety analyses for the auxiliary systems, steam and power conversion systems, and radioactive waste management are presented. (FS)

12467 (DOCKET-50440-2) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Information Requested by the Attorney General for Antitrust Review. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 559p. (DOCKET-50441-2). Dep. NTIS $29.50.

12468 (DOCKET-50440-3) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 1. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 264p. (DOCKET-50441-3). Dep. NTIS $15.25.

The two unit Perry Nuclear Power Plant to be located on Lake Erie, 35 miles northeast of Cleveland, Ohio, consists of boiling water reactors with γ rated core thermal power of 3579 MW(t) and design power of 3758 MW(t). Unit net outputs will be 1205 MW(e) and 1265 MW(e). Volume 1 of the PSAR includes the plant description, comparison with similar facilities, identification of agents and contractors, and plant safety operational analysis. (FS)

12469 (DOCKET-50440-4) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Volume 2. (Cleveland Electric Illuminating Co., Ohio). 22 Jun 1973. 323p. (DOCKET-50441-4). Dep. NTIS $18.25.

The safety analysis for the reactor site characteristics is given including the geography and demography; nearby industrial, transportation, and military facilities; meteorology; hydrology; and geology and seismology. (FS)

12470 (RAI-73-5) REGULATORY ADJUDICATION ISSUANCES, MAY 1973. (Technical Information Center (AEC), Oak Ridge, Tenn.). 15 Jun 1973. 71p. TIC.

Issuances received from the U. S. Atomic Energy Commission, the Atomic Safety and Licensing Appeal Boards, and the Atomic Safety and Licensing Boards are presented. (JWR)

GENERAL

Energy Utilization and Economics

Refer also to abstract 10895.

12471 (BNL-17897) IMPACT OF NUCLEAR POWER ON THE PUBLIC; THE AMERICAN EXPERIENCE. Bond, V. P. (Brookhaven National Lab., Upton, N. Y.). Jan 1973. 73p. Dep. NTIS $5.75.

Lecture at the Kernforschungsanlage, Juelich, West Germany.

The American experience with respect to electrical power production, usually only discusses the risks and benefits of one power source (nuclear) and one possible hazard (radiation from routine releases). Discussions and analyses now deal with all feasible power sources, as well as the costs and benefits associated with fuel production, the operation of such sources, fuel transportation, and waste disposal. A number of attempts have been made to assess the total benefits and risks of nuclear versus fossil fuel plants. Data have concluded that the overall cost in terms of possible damage to health and the environment is least for nuclear power, next for oil, and the greatest for coal-fired plants. In addition to developing a long-lasting energy supply, such as through the nuclear approach, attention must be given to devising means of utilizing the limited fossil fuels, especially coal, in a manner that is much less contaminating and more efficient than at present. (JCW)

12472 (BNL-50355) ENERGY, ENVIRONMENT AND PLANNING: THE LONG ISLAND SOUND REGION. Proceedings of a Conference held at Brookhaven National Laboratory, October 5-7, 1971. Goldberg, M. D. (ed.). (Brookhaven National Lab., Upton, N. Y.). 12 Oct 1972. Contract AT(30-1)-16. 177p. (CONF-711077-). Dep. NTIS $3.00.

Twenty papers presented at the conference were: The National Context; Long Island in the Region; Energy in the Long Island Sound Region; The Nature and Flexibility of Energy Demand in the United States; The Ecological Effect of Energy: A Basis for Policy in Regional Planning; Current Knowledge and Research Related to Environmental Aspects of Energy Production; Biology of Long Island Sound; Circulation and Energy Balance in Long Island Sound; The Structure of Planning; Energy Planning in the Long Island Sound Region; Planning Options and Political Realities; How to Keep the Lights on at Least Until 1980; Options in Power Generation and Transmission; and Considerations Bearing on the Need for New Institutions in the Energy Planning Field. Panel presentations included papers on the utilities, the planning community, the legal community, the technical community, the public, and the news media. (JCW)

12473 (COO-2260-2) ELECTRICAL POWER GENERATION COMPARATIVE COSTS AND BENEFITS. A One-Week Workshop for High School Science Teachers. Final Report. Carbon, M. W.; Hartwig, K. T. (Wisconsin Univ., Madison). 28 Feb 1973. Contract AT(11-1)-2260. 17p. Dep. NTIS $3.00.

A workshop covering basic nuclear power generation and the tradeoffs and problems that exist between nuclear power and alternative means to generate electricity was held between August 7-11, 1972 for forty high-school teachers at the Madison campus of the University of Wisconsin. A feedback conference was held January 13, 1973. A summary and evaluation of the conference were made. (JCW)

12474 (LA-tr-73-5) REFRIGERATING SYSTEM FOR LONG-DISTANCE POWER CABLES. Tomiyama, S.; Akiyama, Y. Translated from Cryog. Eng. (Tokyo); 7: No. 3, 88-101 (1972). 30p. Dep. NTIS $3.50.

Expanding demands on electric power will force the introduction of very-high-density energy transport systems covering considerable distances because appropriate sites for GW-class power plants are now quite limited and remote. Engineering problems on refrigeration of the superconducting or cryoresistive cables are discussed. Technical restrictions from first-stage cooling-down and safeguard design are the main factors to determine the size of the cooling pipe. (JCW)

12475 (ORNL-NSF-EP-49) ELECTRICITY DEMAND IN THE UNITED STATES: AN ECONOMETRIC ANALYSIS. Mount, T. D.; Chapman, L. D.; Tyrrell, T. J. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 29p. (CONF-730205-5). Dep. NTIS $3.50.

From conference on energy, demand, conservation, and institutional problems; Cambridge, Massachusetts, USA (12 Feb 1973).

The growth of demand for electricity since 1945 is attributed to five factors: population, income, and the prices of electricity, substitute fuels (natural gas), and complementary products such as household appliances. The data are annual observations for 48 contiguous states from 1946 to 1970. Single-equation models are fitted for three consumer classes (residential, commercial, and industrial) with the quantity of electricity as the dependent variable. Both constant and variable elasticity models are estimated. In all cases, a lagged dependent variable is used as a regressor, implying that demand adjusts through time to changes of the explanatory variables (geometric lag distribution). With a lagged dependent variable present, ordinary least-squares (OLS) estimators are inconsistent if the residuals are serially correlated. For this reason, a consistent instrumental variable (IV) estimator is used to check the OLS estimates. The estimated adjustment rates are higher with IV than with OLS. However, the long-run elasticities have similar magnitudes using both methods. (auth)

12476 (ORNL-TM-4228) STATUS REPORT ON COLD-VAPOR STUDIES. Lyon, R. N.; Milora, S. L.; Fuller, L. C.; Eissenberg, D. M. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $3.00.

Although various heat sources are being considered, the present detailed effort is on an ammonia system to replace the subatmospheric portion of a nuclear power station. Thermophysical properties for 19 compounds are being collected with emphasis on ammonia because of its requirement for the smallest equipment and simple ducting. The properties include PVT data, enthalpy, entropy, specific heat, thermal conductivity, viscosity, surface tension, and Prandtl number for the subcooled liquid, saturated liquid, saturated vapor, and superheated vapor regions. The investigation consists of fluid properties, component studies, system studies, and cost studies. (JCW)

12477 (SLA-73-163) PERSPECTIVES IN U. S. ENERGY RESOURCE DEVELOPMENT. Plumlee, R. H. (Sandia Labs., Albuquerque, N. Mex.) Mar 1973. 113p. Dep. NTIS $7.75.

The extent, availability, cost, and development schedules of existing and potential domestic U. S. energy resources are surveyed in the context of projected U. S. energy demand. These energy components include fossil fuels and their conversion to clean synthetic fuels, nuclear fuel supplies, geothermal energy, wind power, thermonuclear fusion, and solar energy. The cost of solar energy utilization in several prospective applications is treated in considerable detail. (8 tables, 7 figures, 99 references) (auth)

12478 (SLA-73-5411) SOLAR COMMUNITY. Stromberg, R. P. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 8p. (CONF-730517-1). Dep. NTIS $3.00.

From energy crisis symposium; Albuquerque, New Mexico, USA (3 May 1973).

The problems of concentrating the energy from the Sun and the expense of that energy, and maximum use of that energy in a New Mexico community are examined. Heating a fluid with solar collectors and using the energy in the fluid for uses as it cools is explained in the "Solar Community". (JCW)

12479 (TID-26136) HYDROGEN AND OTHER SYNTHETIC FUELS. A Summary of the Work of the Synthetic Fuels Panel. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Sep 1972. 135p. GPO $2.25.

The development of hydrogen as a synthetic fuel is attractive because it is essentially clean burning, the main combustion product being water; it may be substituted for nearly all fuel uses; it can be produced from domestic resources; it is available from a renewable and universal raw material—water; and nearly all primary energy sources, nuclear, solar, etc., may be used in its production. The main obstacles to the use of hydrogen as a universal fuel are its high cost relative to the current low prices for fossil fuels and, for some applications, the unresolved problems of handling a low-density or a cryogenic fluid. Safety considerations are discussed. The various options for the production of hydrogen, namely, electrolysis, thermochemical, biological, radiolytic, and various combinations, and the production of other synthetic fuels, particularly those made from hydrogen are discussed. Other synthetic fuels considered include ammonia (NH_3), hydrazine (N_2H_4), methanol (CH_3OH), methane (CH_4), ethanol (C_2H_5OH), and gasoline (C_8H_{18}). (JCW)

12480 (TID-26336) POTENTIAL FOR ENERGY CONSERVATION THROUGH INCREASED EFFICIENCY OF USE. Hirst, E.; Moyers, J. C. (Oak Ridge National Lab., Tenn.). 1973. 22p. Dep. NTIS $3.25.

Opportunities exist for significantly increasing the efficiency

with which energy is used in the United States. This paper discusses such opportunities for (a) the transportation sector (shifts from energy-intensive modes to energy-efficient modes, increased use of existing equipment, and technological changes to increase vehicle energy efficiency) and (b) the household sector (additional building insulation, electric heat pumps rather than electric-resistance heating, energy-efficient air conditioners, and addition of insulation of water heaters). Such energy efficiency improvements may require institutional and social changes, but technologies are generally available to implement such strategies. The benefits to the nation in terms of energy conservation, reduced reliance on energy imports and improved balance of payments, reduced adverse environmental impacts, lower dollar costs, and a return to a more conservative resource-use ethic are potentially large. Policies to achieve such goals would involve some life-style changes and important institutional decisions, but they do not imply a return to "caves and candles." (auth)

12481 LONG-RANGE APPROACHES FOR RESOLVING THE ENERGY CRISIS. Weinberg, A. M. (Oak Ridge National Lab., TN). Mech. Eng.; 95: No. 6, 14-18(Jun 1973).

Long-range possibilities for generation of prime energy (other than the nuclear breeder) are basically only three: solar, fusion, and geothermal. Predictions in favor of one or the other of these possibilities tend to take on the character of prophesy, principally because the prophet knows he will probably be dead by the time the returns are in. Fermi, for example, discussed the fast breeder, not expected before the mid-eighties, in 1943. The prophets may be right, but a prudent overall energy policy must be based on the two firm alternatives—clean energy from coal and from nuclear sources, particularly from the breeder. (auth)

12482 POTENTIAL OF SOLAR ENERGY APPLICATIONS. Glaser, P. E. (Arthur D. Little, Inc., Cambridge, MA). AIChE Symp. Ser.; 68: No. 125, 55-65(1972).

The total influx from solar, geothermal, and tidal energy into the Earth's surface environment is estimated to be $173{,}000 \times 10^{12}$ watts. Solar radiation accounts for 99.98% of it. The Sun's contribution to the energy budget of the Earth is 5,000 times the energy input from all other sources combined. The applications of heating from solar energy include domestic hot water heating, residential cooling and heating. Photochemical reactions are discussed in view of harnessing the energy involved for domestic applications. Direct energy conversion based on photovoltaic conversion of solar energy into dc, employing solar cells, is discussed. Focusing collectors based on mirror reflectors or Fresnel lens concentrators can be used to obtain high temperatures. A system based on selective radiation-absorbing surfaces maintained inside an evacuated cylinder, with the heat transferred to a circulating gas or fluid has been proposed. Sun-heated oceans present a possible energy source. The harnessing of energy in space was discussed. (JCW)

Management

12483 (AECL-4427, pp 2-5) AECL'S INTERACTION WITH INDUSTRY. Perryman, E. C. W. (Chalk River Nuclear Labs., Ont.). Win 1972.

The methods by which AECL cooperates with industry are briefly described: (1) purchase of equipment, (2) research contracts, and (3) industrial staff in AECL laboratories. (MOW)

12484 (NP-19755) SIXTH GENERAL REPORT ON THE ACTIVITIES OF THE COMMUNITIES, 1972. (European Communities, Brussels (Belgium). Commission). Feb 1973. 471p. Dep. NTIS (U. S. Sales Only) $25.75.

The Sixth General Report on the activities of the European Communities for 1972 is summarized in seven chapters: development of the institutions; enlargement and agreements with non-acceding EFTA countries; functioning of the Common Market; towards economic and monetary union; external relations; institutions of the Communities; and Community law. (JCW)

Mathematics and Computers

Refer also to abstract 10876.

12485 (ANCR-1116) PERFORMANCE MEASUREMENTS ON THE NRTS IBM 360/75 COMPUTER SYSTEM. Beardsley, B. M. (Aerojet Nuclear Co., Idaho Falls, Idaho). May 1973. Contract AT(10-1)-1375. 16p. Dep. NTIS $4.00.

This report describes the National Reactor Testing Station (NRTS) IBM 360/75J computer system, the processing environment, and the methods used to measure different aspects of systems performance. Measurement tools include hardware and software monitors, benchmark tests, the IBM System Management Facility Records, and other data which are routinely collected in the process of allocating and recovering operational expenses. (MOW)

12486 (IS-3041) TASKMASTER OPERATOR'S GUIDE. Campbell, J. H.; Helland, B. (Ames Lab., Iowa). Jan 1973. Contract W-7405-eng-92. 52p. Dep. NTIS $4.75.

This document is designed for the users of the TASKMASTER real-time operating system. It provides each user with the necessary information for him to use his teletypewriter as a console for dynamic interaction with the operating system, experimental interfaces, and his executing programs. Also included is a description of all available utility programs. (auth)

12487 (IS-3042) GUIDE TO THE TASKMASTER REAL-TIME MULTITASKING CONTROL SYSTEM. Campbell, J. H.; Helland, B. (Ames Lab., Iowa). Dec 1972. Contract W-7405-eng-82. 69p. Dep. NTIS $5.50.

This report describes the TASK 65 high level programming language and its associated multitasking and experimental control facilities that are implemented in the TASKMASTER real-time control system. The system currently handles six diffractometer type experiments with all user programming done in the TASK 65 language. (auth)

12488 (ORNL-4851) MATHEMATICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1972. (Oak Ridge National Lab., Tenn). Apr 1973. Contract W-7405-eng-26. 302p. Dep. NTIS $3.00.

The contents of this report appear in the following divisions: mathematical research, computing applications, systems programming, computer services, and mathematical statistics. Most of the items in the report are quite short and give only a brief description of the project under consideration. (28 figures, 5 tables) (RWR)

12489 (SLA-73-5419) SIMULATION OF RELATIVISTIC ELECTRON BEAM DIODES. Poukey, J. W.; Freeman, J. R.; Yonas, F. G. (Sandia Labs., Albuquerque, N. Mex.). 1973. 22p. (CONF-730529-4). Dep. NTIS $3.25.

From 12th symposium on electron, ion, and laser beam technology; Cambridge, Massachusetts, USA (21 May 1973).

Program DISIC, a new diode simulation code, was developed to study the behavior of high ν/γ diodes. The code is based on a two-dimensional finite-size particle simulation model, and is designed to provide good resolution of small anode-cathode gaps. Results are shown which (1) compare with earlier calculations, (2) compute electron trajectories in strongly self-pinched diodes, and (3) compute electron trajectories for a diode having a conical cross section. (auth)

12490 (UCID-16281) ADAPTING A MINICOMPUTER PROGRAMMING SYSTEM TO THE INTEL MCS-4 AND MCS-8 MICROCOMPUTER SYSTEMS. Peterson, R. L. (California Univ., Livermore. Lawrence Radiation Lab). 27 Jul 1972. 19p. Dep. NTIS $3.00.

As with any computer system, the INTEL MCS-4 and MCS-8 micro-computer systems need a programming system. Minicomputer systems have been used for several years—thus it was natural to try to apply those software systems to these microprocessors. Many of the mini-computer systems are built around the Digital Equipment Corporation, PDP-8 class processor; therefore, it was easiest to use DEC's editors, assemblers, and loaders as the basis for programming both the MCS-4 and MCS-8. Although this report deals primarily with the MCS-4 system, these techniques can also be applied to the MCS-8. (auth)

Miscellaneous

12491 (AECL-4427, pp 6-8) BRISTOL AEROSPACE: WESTERN MEMBER OF THE CANADIAN NUCLEAR INDUSTRY. Burrows, K. F.; Thexton, H. E. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Win 1972.

The involvement of Bristol Aerospace in the Canadian nuclear industry is discussed. Their successes in the design and fabrication of fuel channels are described. (JWR)

12492 (AERE-R-7296) EFFECT OF RESIN MATRIX PROPERTIES ON THE IMPACT AND MECHANICAL PROPERTIES OF UNIDIRECTIONAL CFRP. Hancox, N. L.; Wells, H. (Atomic Energy Research Establishment, Harwell (England)). Mar 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

By varying the properties of the epoxy resin matrix, with different hardeners and a rubber additive, it is possible, for a given batch of carbon fiber, to increase the Izod impact strength of a unidirectional composite by 130%, though in absolute terms the value is still not high. The flexural modulus and flexural and interlaminar shear strengths can be changed by 51%, 48%, and

89% respectively. Attempts to coat carbon fibres with a rubber solution or epoxy resin size prior to making the composite did not lead to an increased impact strength. (auth)

12493 (BDX-613-827) FILAMENT-WINDING A THIN-WALL FIBERGLASS HEMISPHERE. Bruegge, D. C. (Bendix Corp., Kansas City, MO). Mar 1973. Contract AT(29-1)-613. 44p. Dep. NTIS $4.25.

For Missouri Univ.

A survey of materials and processes was conducted, and several methods of fiber reinforcement, such as continuous fiber strands, fabrics, and chopped fiber, were considered prior to the selection of the filament-winding process. The continuous fiber strand used in a filament-winding process was selected because it exhibited the greatest composite tensile strength capability. (MOW)

12494 (BDX-613-921) DEVELOPMENT OF A DELIQUESCENT CHEMICAL MAXIMUM HUMIDITY INDICATOR. Final Report. Reif, R. B.; Kurz, P. F.; Coppock, R. A. (Battelle Columbus Labs., Ohio). May 1973. Contract AT(29-1)-613. 29p. Dep. NTIS $4.00.

For Bendix Corp., Kansas City, MO.

An indicator was developed to record the maximum humidity to which components or materials are exposed during manufacturing operations or in transit. A system composed of deliquescent salts and water soluble dyes provides an irreversible color change when discrete levels of relative humidity are exceeded. A dramatic color change results from the solution of the indicating dye in the saturated solution of the deliquescent salt. The relative humidity at which the system will react depends on the formulation of the salt and can be as low at 10%. (auth)

12495 (BNL-17750) EXPERIMENTAL DATA ON PARTICULATE DISPERSION INTO AND WITHIN A FOREST. Part I. Dispersion from Upwind Point Sources. Raynor, G. S.; Hayes, J. V.; Ogden, E. C. (Brookhaven National Lab., Upton, N.Y.). Dec 1972. 96p. Dep. NTIS $7.00.

12496 (BNL-17819) MANGANESE AND CATECHOLAMINES. Cotzias, G. C.; Papavasiliou, P. S.; Mena, I.; Tang, L. C.; Miller, S. T. (Brookhaven National Lab., Upton, N. Y.; State Univ. of New York, Stony Brook). 1972. 16p. (CONF-730441-2). Dep. NTIS $3.00.

From 2nd L-Dopa conference; Princeton, New Jersey, USA (11 Apr 1973).

Diminished cerebral manganese concentrations in the mouse mutant pallid were associated with diminished production of dopamine from exogenous, systematically administered levodopa. Increasing the cerebral concentration of manganese with excess dietary metal increased the endogenous levels of this amine in the adult Swiss albino mouse. In the neonatal Swiss albino mouse, furthermore, gradual increases of both cerebral manganese and of cerebral dopamine levels were demonstrated to proceed as a function of age and with a high statistical correlation with each other. (25 references) (auth)

12497 (BNL-17828) UNEXPECTED FINDINGS WITH APOMORPHINE AND THEIR POSSIBLE CONSEQUENCES. Cotzias, G. C.; Mena, I.; Papavasiliou, P. S.; Mendez, J. (Brookhaven National Lab., Upton, N. Y.; State Univ. of New York, Stony Brook). 1973. 10p. (CONF-730441-3). Dep. NTIS $3.00.

From 2nd L-Dopa conference; Princeton, New Jersey, USA (11 Apr 1973).

Considerations are presented that might explain how apomorphine can be centrally active, whereas dopamine ordinarily is not, and why apomorphine can be synergistic to some actions of levodopa and antagonistic to others. (auth)

12498 (BNL-17849) CHRONIC TREATMENT WITH LEVODOPA AND GROWTH HORMONE RELEASE. Mena, I.; Cotzias, G. C.; Papavasiliou, P. S.; Mendez, J.; Brown, F. C. (Brookhaven National Lab., Upton, N. Y.; State Univ. of New York, Stony Brook). 1973. 15p. (CONF-730441-4). Dep. NTIS $3.00.

From 2nd L-Dopa conference; Princeton, New Jersey, USA (11 Apr 1973).

Evidence suggests that levodopa tends to change the pattern by which growth hormone is released from the pituitary, without significantly affecting the total output of hormone per 24 hours. Since not all patients were compared in both the treated and the untreated states, this conclusion is subject to confirmation. Despite the fact that evidence was found that the release of growth hormone changed the control of parkinsonism, this possibility must be reinvestigated with protocols differing from those used here, in view of the animal experiments. (auth)

12499 (BNL-17850) FREE RADICALS IN THE HUMAN NERVOUS SYSTEM. Borg, D. C. (Brookhaven National Lab., Upton, N. Y.). 1973. 15p. (CONF-730441-1). Dep. NTIS $3.00.

From 2nd L-Dopa conference; Princeton, New Jersey, USA (11 Apr 1973).

12500 (BNWL-1750(Pt.2), pp 3.6-3.7) GEOCHEMICAL OCEAN SECTIONS STUDY (GEOSECS). Robertson, D. E.; Silker, W. B. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12501 (BNWL-1750(Pt.2), pp 4.3-4.4) BIAS IN CAPTURE-RECAPTURE STUDIES. Gilbert, R. O. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12502 (BNWL-1750(Pt.2), pp 4.4-4.5) SAMPLING SAGEBRUSH ON ALE. Gilbert, R. O.; Rickard, W. H. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12503 (BNWL-1750(Pt.2), pp 4.5-4.7) ANTARCTIC SEAL STUDY. Eberhardt, L. L. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12504 (BNWL-1750(Pt.2), pp 5.1-5.3) INFLUENCE OF ENVIRONMENTAL FACTORS ON ARID SOIL RESPIRATION RATE. I. Temperature and Moisture: A Preliminary Model. Wildung, R. E.; Garland, T. G.; Schmidt, R. L. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12505 (BNWL-1750(Pt.2), pp 5.3-5.4) INFLUENCE OF ENVIRONMENTAL FACTORS ON ARID SOIL RESPIRATION RATE. II. Livestock Grazing. Wildung, R. E.; Schmidt, R. L. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12506 (BNWL-1750(Pt.2), pp 5.4-5.5) MERCURY LEVELS IN PARTICULATE MATTER SUSPENDED IN WATERS OF THE LOWER COLUMBIA RIVER WATERSHED. Wildung, R. E.; Garland, T. G.; Schmidt, R. L. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12507 (BNWL-1750(Pt.2), pp 6.14-6.15) TRACE ELEMENT ANALYSES OF WHITEFISH. Cushing, C. E.; Watson, D. G. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12508 (BNWL-1750(Pt.2), pp 6.15-6.16) TAXONOMY OF RATTLESNAKE SPRINGS (ALE) ALGAE. Lippert, B. E.; Cushing, C. E. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12509 (BNWL-1750(Pt.2), pp 6.16) FALL CHINOOK SALMON POPULATION CENSUS. Watson, D. G. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12510 (BNWL-1750(Pt.2), pp 6.19-6.20) FINE STRUCTURAL EFFECTS OF TEMPERATURE IN FISH. Hampton, J. C.; Adee, R. R. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12511 (BNWL-1750(Pt.2), pp 6.20-6.21) COMBINED EFFECTS: TEMPERATURE PLUS MERCURY AND CHLORINE. Thatcher, T. O.; Lusty, E. W. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12512 (BNWL-1750(Pt.2), pp 6.21-6.23) DISSOLVED GAS SUPERSATURATION. Fickeisen, D. H.; Schneider, M. J. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12513 (BNWL-1750(Pt.2), pp 6.23-6.25) FURUNCULOSIS AND COLUMNARIS DISEASE IN COARSEFISHES AND ANADROMOUS SALMONIDS. Fujihara, M. P. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12514 (BNWL-1750(Pt.2), pp 7.1-7.3) HERBAGE YIELD IN RELATION TO SOIL WATER ASSIMILATED NITROGEN. Cline, J. F.; Rickard, W. H. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12515 (BNWL-1750(Pt.2), pp 7.3-7.4) COMPARISON OF ANNUAL YIELDS IN CHEATGRASS AND SAGEBRUSH-BUNCHGRASS COMMUNITIES, 1972. Rickard, W. H.; Cline, J. F.; Gilbert, R. O. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12516 (BNWL-1750(Pt.2), pp 7.4-7.5) AUTUMNAL VERSUS VERNAL GROWTH IN CHEATGRASS COMMUNITIES. Rickard, W. H.; Cline, J. F.; Gilbert, R. O. Mar 1973.

In Pacific Northwest Laboratory annual report for 1972.

12517 (BNWL-1750(Pt.2), pp 7.5-7.6) UPTAKE OF ^{45}Ca, ^{65}Zn, ^{35}S, AND ^{32}P BY BARLEY FROM HALOPHYTE AFFECTED

SOIL. Cline, J. F.; Rickard, W. H. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12518 (BNWL-1750(Pt.2), pp 7.6-7.8) MODIFIED ENVIRONMENT OUTDOOR RESEARCH FACILITY. Hinds, W. T. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12519 (BNWL-1750(Pt.2), pp 7.8-7.10) SIMPLE LYSIMETER TECHNIQUE FOR COMPARISON OF WATER USE AND HERBAGE YIELD IN AN ANNUAL GRASSLAND COMMUNITY. Hinds, W. T. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12520 (BNWL-1750(Pt.2), pp 7.10-7.11) FLORA OF THE ALE RESERVE. O'Farrell, J. T. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12521 (BNWL-1750(Pt.2), pp 7.12-7.13) IMPACT OF CATTLE GRAZING ON SHRUB-STEPPE VEGETATION. Rickard, W. H.; Gilbert, R. O.; Cline, J. F. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12522 (BNWL-1750(Pt.2), pp 7.13-7.14) CATTLE GRAZING ON A PRISTINE GRASSLAND. O'Farrell, T. P. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12523 (BNWL-1750(Pt.2), pp 7.14-7.15) SMALL MAMMAL POPULATIONS ON A GRAZED GRASSLAND. O'Farrell, T. P.; Hedlund, J. D.; Gies, R. A.; Fitzner, R. E. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12524 (BNWL-1750(Pt.2), pp 7.15-7.16) IMPACT OF GRAZING ON RANGELAND ARTHROPODS. Rogers, L. E.; Woodley, N. E. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12525 (BNWL-1750(Pt.2), pp 7.20-7.21) POPULATION DYNAMICS OF POCKET MICE, PEROGNATHUS PARVUS, ON THE ALE RESERVE. O'Farrell, T. P.; Hedlund, J. D.; Gies, R. A. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12526 (BNWL-1750(Pt.2), pp 7.21-7.23) POPULATION DYNAMICS OF PEROGNATHUS PARVUS ON MANIPULATED SHRUB STEPPE ECOSYSTEMS. O'Farrell, T. P.; Hedlund, J. D.; Gies, R. A.; Fitzner, R. E. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12527 (BNWL-1750(Pt.2), pp 7.23-7.24) TAGGING HANFORD DEER, ODOCOILEUS HEMIONUS. Hedlund, J. D.; Gies, R. A.; O'Farrell, T. P. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12528 (BNWL-1750(Pt.2), pp 7.24-7.25) REPRODUCTIVE BEHAVIOR OF THE NORTHERN GRASSHOPPER MOUSE, ONYCHOMYS LEUCOGASTER FUSCOGRISEUS. O'Farrell, T. P.; Hedlund, J. D.; Gies, R. A. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12529 (BNWL-1750(Pt.2), pp 7.25-7.26) LABORATORY COLONY OF SAGEBRUSH VOLES, LAGURUS CURTATUS. Gies, R. A.; O'Farrell, T. P. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12530 (BNWL-1750(Pt.2), pp 7.26) INSECT-PLANT ASSOCIATION. Rogers, L. E.; Woodley, N. E. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12531 (BNWL-1750(Pt.2), pp 7.26-7.27) COMPARISONS OF BEETLE POPULATIONS IN DESERT STEPPE COMMUNITIES. Rogers, L. E.; Rickard, W. H. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12532 (BNWL-1750(Pt.2), pp 7.28-7.29) CORRELATIONS BETWEEN CLIMATOLOGICAL FLUCTUATIONS AND A PHILOLITHUS DENSICOLLIS (HORN) POPULATION (COLEOPTERA: TENEBRIONIDAE). Hinds, W. T.; Rickard, W. H. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12533 (BNWL-1750(Pt.2), pp 7.29) GRASSHOPPER ABUNDANCE IN AN ABANDONED CULTIVATED FIELD. Rogers, L. E. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12534 (BNWL-1750(Pt.2), pp 7.30-7.31) CANADA GOOSE POPULATIONS ON THE HANFORD RESERVATION, 1972. Fitzner, R. E.; Sweany, H. A.; O'Farrell, T. P. Mar 1973.
In Pacific Northwest Laboratory annual report for 1972.

12535 (CONF-720986-1) PLANNING COOPERATION IN HUMAN BONE MARROW TRANSPLANT RESEARCH. Congdon, C. C.; Bortin, M. M.; Morris, W. M. (Mount Sinai Medical Center, Milwaukee, Wis. (USA). Winter Research Lab.). 1972. Contract AT(49-7)-3111. 32p. Dep. NTIS $3.75.
From meeting on bone marrow transplantation in man; Racine, Wisconsin, USA (23 Sep 1972).

12536 (CONF-721144-1). SCISSION OF THE SULFUR-SULFUR BOND IN DIPURINYL AND DIPYRIMIDINYL DISULFIDES BY CYANIDE. Pal, B. C.; Schmidt, D. G. (Oak Ridge National Lab., Tenn.). 1972. 34p. Dep. NTIS $3.75.
From 24th southeastern regional meeting of the American Chemical Society; Birmingham, Alabama, USA (2 Nov 1972).

12537 (CONF-730613-2) DETERMINATION OF TRACE ORGANIC CONTAMINANTS BY HIGH-RESOLUTION LIQUID CHROMATOGRAPHY. Pitt, W. W. Jr.; Scott, C. D.; McBride, M. D. (Oak Ridge National Lab., Tenn.). 1973. 15p. Dep. NTIS $3.00.
From seventh annual conference on trace substances in environmental health; Columbia, Missouri, USA (12 Jun 1973).
Automated high-resolution liquid chromatographs, previously developed for analysis of molecular biochemical constituents in human body fluids, were applied to analysis of various polluted waters. Samples of polluted natural waters were collected at different sites, concentrated up to 10,000-fold, and chromatographed on a high-pressure anion exchange column. Monitoring of the column eluate for ultraviolet absorbance and cerate oxidizability revealed the presence of numerous organic contaminants at concentrations less than 1 μg/liter. (auth)

12538 (CONF-730613-3) APPLICABILITY OF THE RF-FURNACE TECHNIQUE FOR AA AND AE ANALYSES OF TRACE ELEMENTS IN ENVIRONMENTAL SAMPLES. Talmi, Y.; Crosmun, R. (Oak Ridge National Lab., Tenn.; Tennessee Univ., Knoxville). 1972. 18p. Dep. NTIS $3.00.
From seventh annual conference on trace substances in environmental health; Columbia, Missouri, USA (12 Jun 1973).

12539 (COO-894-10) ENERGY TRANSFER AND UTILIZATION IN BIOLOGICAL SYSTEMS. Progress Report, September 1, 1972-August 31, 1973. Lumry, R. (Minnesota Univ., Minneapolis. Lab. for Biophysical Chemistry). [nd]. Contract AT(11-1)-894. 8p. Dep. NTIS $3.00.
The time-resolved-emission spectrometer (TRES) was applied, using Ware's method for deconvolution of emission arc spectrum from fluorescence spectrum, to small indole compounds. Two lifetimes were found with some compounds and may be responsible for the uncertainties (presumed due to missing states) still associated with the fluorescence and electron-ejection behavior of indole. The TRES method applied to staphylococcus nuclease, human serum albumen, ribonuclease T_1, chymotrypsin, and lysozyme demonstrates a wide range of internal mechanical behavior via the "internal viscosity," i.e., the ability for motional response of the environment of a single indole group on excitation of that group. Indole groups in the so-called unfolded conformations of proteins have very temperature-dependent fluorescence properties that allow characterization of this little-understood protein state. Although results are only preliminary, it is probable that specific tests of enzymic function and protein-water interaction hypotheses are now possible with the method. (auth)

12540 (COO-1407-6) DEPOSITION OF ATMOSPHERIC PARTICULATE MATTER BY CONVECTIVE STORMS: THE ROLE OF THE CONVECTIVE UPDRAFT AS AN INPUT MECHANISM. Gatz, D. F. (Michigan Univ., Ann Arbor. Dept. of Meteorology and Oceanography). Mar 1966. Contract AT(11-1)-1407. 228p. Dep. NTIS $13.25.
Thesis. Submitted to Michigan Univ. (1966).
Quantitative evidence regarding the mechanism by which airborne particulate matter enters convective storms is provided. The relationships are clarified among (1) time profiles of contaminant concentrations, (2) time profiles of rainfall rate, (3) input mechanism, and (4) mechanism of particle capture, each with respect to two dissimilar contaminants. (MOW)

12541 (COO-1783-12) PHOSPHOENOLPYRUVATE CARBOXYTRANSPHOSPHORYLASE. VII. An Investigation of the Reaction Mechanism with ^{18}O. Enolpyruvate and CO_2 Fixation. O'Brien, W. E.; Singleton, R. Jr.; Wood, H. G. (Case-Western Reserve Univ., Cleveland, Ohio. Dept. of Biochemistry). 1973. Contract AT(11-1)-1783. 28p. Dep. NTIS $3.50.

12542 (COO-1801-29) PROTEIN SYNTHESIS IN DELAYED IMPLANTING MOUSE OVA. Progress Report, May 1, 1972-April 31, 1973. Weitlauf, H. M. (Kansas Univ., Kansas City. Medical Center). 1973. Contract AT(11-1)-1801. 6p. Dep. NTIS $3.00.

12543 (COO-2027-6) MOTION OF IONS IN SOLID HELIUM. Progress Report for the Period May 1, 1971-January 31, 1973. (Case-Western Reserve Univ., Cleveland, Ohio. Dept. of Physics). 1973. Contract AT(11-1)-2027. 55p. Dep. NTIS.

This report details the results obtained on six experiments and the redesign of another in addition to the completion of a $^3He-^4He$ dilution refrigerator. Each of the experiments is related to the understanding of ions and like entities in liquid and solid He and to the study of excitations in solid helium. These experiments are: (1) measurement of mobilities of charge carriers in solid He; (2) vacancy relaxation times in solid He; (3) electron spin resonance in liquid He; (4) electron tunneling from the bubble state in liquid He in presence of strong electric fields; (5) lifetime measurements of orthopositronium in liquid and solid He; (6) search for Lyman-α radiation from positronium; (7) extraction of charged droplets from the surface of liquid helium. In the course of one of these experiments, electron spin resonance, an alternate technique to Mott scattering was developed for study of electron spin polarization (ESP) in ferromagnetic materials. It is an exciting new method for measuring the sign and relative magnitude, and possibly the absolute magnitude of ESP. Each experiment is discussed separately. (auth)

12544 (COO-3148-7) MECHANISMS OF ACID-BASE CATALYSIS AND STUDIES IN DEUTERIUM OXIDE AS SOLVENT. Final Report. Long, F. A. (Cornell Univ., Ithaca, N. Y.). 10 May 1973. Contract AT(11-1)-3148. 7p. Dep. NTIS $3.00.

12545 (COO-3151-20) EXPERIMENTAL PHONON PHYSICS PROGRESS REPORT, APRIL 1, 1972-MARCH 31, 1973. Pohl, R. O.; Sievers, A. J. (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). [nd]. Contract AT(11-1) -3151. 25p. Dep. NTIS $3.25.

12546 (COO-3254-10) CULTURE OF SALT MARSH MICROORGANISMS AND MICROMETAZOA. Lee, J. J.; Mueller, W. A. (City Coll., New York. Dept. of Biology). 1973. 32p. (CONF-721092-1). Dep. NTIS $3.75.

12547 (COO-3407-5) TEMPERATURE DEPENDENCE OF THE FLOW STRESS OF Cu_3Au AT LOW TEMPERATURES. Pope, D. P. (Pennsylvania Univ., Philadelphia (USA). Lab. for Research on the Structure of Matter). 1972. 10p. Dep. NTIS $3.00.

Compression flow stress measurements were made on well-ordered single crystals of Cu_3Au over the temperature range 4 to 300°K. These tests showed that the temperature dependence of the yield stress in Cu_3Au below 200°K is similar to that observed in pure fcc metals. These results differed widely from results in the literature on polycrystalline samples. Further tests on both well ordered and fully disordered polycrystalline samples confirmed the similarity in behavior between well ordered Cu_3Au and pure fcc metals at low temperatures. It is suggested that the results in the literature show an anomalously high temperature dependence due to impurities in the material. (auth)

12548 (COO-3479-4) FATIGUE-ENHANCEMENT OF DIFFUSION. Progress Report for Year Ending May 31, 1973. Herman, H. (State Univ. of New York, Stony Brook). 1973. Contract AT(11-1)-3479. 23p. Dep. NTIS $3.25.

It was found that low-amplitude cyclic straining can give rise to high vacancy concentrations, with an attendant enhancement in solute diffusion. This effect is being studied by cyclic strain-induced ordering of initially disordered alpha-brass. Both a frequency effect and an amplitude effect were observed, and they are being studied in detail. Cryogenic generation of defects was achieved with results that at least initially support previous conclusions from this program. This study has clear technological implications, since fatigue-enhancement of diffusion can threaten the viability of strengthening transition phases by giving rise to resolution or coarsening. (auth)

12549 (COO-5000-2039-20) ELECTRONIC EXCITATION OF COMPOSITE SYSTEMS. Technical Progress Report. El Bayoumt, M. A. (Michigan State Univ., East Lansing. Dept. of Biophysics). 17 May 1973. Contract AT(11-1)-2039. 5p. Dep. NTIS $3.00.

12550 (EUR-4982) AIR LEAD CONCENTRATIONS IN THE EUROPEAN COMMUNITY. Yearly Report: April 1971-March 1972. (European Communities, Brussels (Belgium). Commission). 1973. 167p. (In German). Dep. NTIS (U. S. Sales Only) $10.50. EUR FB 210.-.

A first series of atmospheric lead measurements is presented, allowing an appreciation of the air lead levels in over 40 locations of the European Community and the United Kingdom. The measurements are a result of the various actions undertaken by the Commission in the past 18 months within the general framework of the program aimed at the reduction of air pollution by motor vehicles following the problems raised by the environmental health implications due to the presence of lead in the exhaust gases of such vehicles. This report is the first "reference" document for the information of Member States regarding air pollution levels in the Community. (auth)

12551 (IJS-R-609) SOME REACTIONS OF CHROMIUM, IRON, AND COBALT FLUORIDES WITH XENON DIFLUORIDE AND HEXAFLUORIDE. Zemva, B.; Slivnik, J. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Oct 1972. 7p. (CONF-720856-7). Dep. NTIS (U. S. Sales Only) $3.00.

From fourth European symposium on fluorine chemistry; Ljubljana, Yugoslavia (28 Aug 1972).

In the CrF_2-XeF_6 system, a compound of composition $XeCrF_{10}$ is formed. Its magnetic susceptibility ($\mu_{eff} = 2.75 \pm 0.01\ \mu_B$) indicates that chromium is in the 4+ state. A compound is formed also in the FeF_2-XeF_6 system. Its composition and properties are given. New preparation method for obtaining CoF_3, CrF_3, and FeF_3 from metal + XeF_2 is discussed. (DLC)

12552 (IJS-R-610) PREPARATION OF PURE XENON TETRAFLUORIDE. Bohinc, M.; Slivnik, J.; Zemva, B. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Oct 1972. 8p. (CONF-720856-1). Dep. NTIS (U. S. Sales Only) $3.00.

From fourth European symposium on fluorine chemistry; Ljubljana, Yugoslavia (28 Aug 1972).

Xenon tetrafluoride of purity better than 99 wt % was obtained by dissociation of the compound formed between sodium fluoride and xenon hexafluoride at 300°C. The possibility of the removal of traces of XeF_2 observed in products thus obtained, using cobalt difluoride is discussed. (auth)

12553 (IJS-R-611) REACTIONS OF MOLYBDENUM AND TUNGSTEN HEXAFLUORIDES WITH ANHYDROUS HYDRAZINE. Frlec, B. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Nov 1972. 13p. (CONF-720856-2). Dep. NTIS (U. S. Sales Only) $3.00.

From fourth European symposium on fluorine chemistry; Ljubljana, Yugoslavia (28 Aug 1972).

MoF_6 and WF_6 react with hydrazine explosively below -80°C. If the hexafluoride vapor diluted with argon is slowly bubbled through excessive hydrazine in a glass apparatus, very dark solutions result in which upon concentration, in the case of Mo, another reaction starts leading to an explosion and damage of the apparatus. The solids isolated from these solutions do not have consistent compositions. Reactions in acetonitrile were also investigated. (auth)

12554 (IJS-R-612) INVESTIGATIONS OF THE SYSTEMS $Br_2-F_2-AsF_5$ AND $Br_2-F_2-BF_3$. Smalc, A. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Nov 1972. 9p. (CONF-720856-5). Dep. NTIS (U. S. Sales Only) $3.00.

From fourth European symposium on fluorine chemistry; Ljubljana, Yugoslavia (28 Aug 1972).

In the first system the existence of three compounds is indicated: $Br_3^+AsF_6^-$, $Br_2^+AsF_6^-$, and $BrF_2^+AsF_6^-$ can be obtained, depending on the mole ratio of reactants used. In the second system only two compounds can be obtained: $Br_3^+BF_4^-$ and $BrF_2^+BF_4^-$, respectively. $Br_2^+AsF_6^-$ is a dark red solid at room temperature, stable only under pressure of a few mm Hg of AsF_5. $Br_3^+BF_4^-$, however, forms dark brown needles with a dissociation pressure that follows the equation $\log p = 11.808 - (2814.5/T)$. (auth)

12555 (IJS-R-613) REACTION OF SOME TRANSITION METAL FLUORIDES WITH ANHYDROUS HYDRAZINE. Glavic, P.; Slivnik, J. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Nov 1972. 12p. (CONF-720856-6). Dep. NTIS (U. S. Sales Only) $3.00.

From fourth European symposium on fluorine chemistry; Ljubljana, Yugoslavia (28 Aug 1972).

ZrF_4, HfF_4, CeF_4, ThF_4, MnF_2, NiF_2, CdF_2, and ZnF_2 were reacted with excess anhydrous hydrazine. The formation of the isolated compounds was checked also by tensimetric titration of the transition metal fluorides with hydrazine. Experimental results are given together with the ir and DTA data of the addition compounds obtained. (auth)

12556 (IJS-R-614) MELTING POINT DETERMINATIONS OF XENON DIFLUORIDE-XENON TETRAFLUORIDE MIXTURES. Ogrin, T.; Bohinc, M. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Nov 1972. 6p. (CONF-720856-4). Dep. NTIS (U. S. Sales Only) $3.00.

From fourth European symposium on fluorine chemistry; Ljubljana, Yugoslavia (28 Aug 1972).

Mixtures of XeF_2 and XeF_4 were made from pure fluorides by weighing and sealed in quartz tubes. Melting was observed visually. The reproducibility of melting temperatures was ±0.1°C. Results are presented and discussed. (DLC)

12557 (IJS-R-615) REACTION BETWEEN XENON AND FLUORINE. Levec, J.; Slivnik, J.; Zemva, B. (Institut Jozef

Stefan, Ljubljana (Yugoslavia)). Dec 1972. 13p. (CONF-720856-3). Dep. NTIS (U. S. Sales Only) $3.00.

From fourth European symposium on fluorine chemistry; Ljubljana, Yugoslavia (28 Aug 1972).

The influence of nickel and silver difluorides, nickel and silver hexafluoromanganates(IV), and nickel difluoride and silver(I) oxides on the reaction between xenon and fluorine at 120°C was investigated. In some cases the reaction proceeds explosively. (DLC)

12558 (JINR-E2-7038) ENERGY OF MAGNETIC EXCITATIONS AND MAGNETIZATION IN COMPRESSIBLE FERROMAGNET. Vukajlovic, F. R.; Vlahov, J. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

An explicit expression for the temperature dependence of the lattice constant in a ferromagnet and its influence on the magnetic excitation spectrum and magnetization in the low-temperature region are obtained. (auth)

12559 (JINR-P4-7152) OVERHAUSER EFFECT IN THE CONDITIONS OF UNEQUILIBRATION OF THE CONDUCTION ELECTRON KINETIC DEGREES OF FREEDOM. Bikkin, Kh. M.; Vlakhov, I. P.; Kalashnikov, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The influence of the unequilibration of the conduction electron kinetic degrees of freedom on the quantity of the nuclear spin dynamic polarization in the Overhauser effect is considered. It is shown that the rise of the electron kinetic temperature in the saturation of the electron paramagnetic resonance can result in an intensive decrease in the nuclear polarization. Some special cases are considered in which the deviation of the kinetic temperature can be considerable and there are some numerical estimations for the quantity derived describing the degree of decrease in the dynamic orientation of nucleus in the Overhauser effect when the conduction electron kinetic degrees of freedom deflect from equilibrium. (tr-auth)

12560 (JUL-934-RW) EVAPORATION BEHAVIOR AND SPECTROCHEMICAL EXCITATION PROCESSES UNDER THE APPLICATION OF DIFFERENT DISCHARGE GASES IN THE CARBON ARC. Mazurkiewicz, M. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Mar 1973. 114p. (In German). Dep. NTIS (U. S. Sales Only) $7.75.

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

The processes of evaporation and excitation in the carbon arc were studied under atmospheres of argon, helium, and argon/oxygen. Using spectrochemical investigations it was possible to determine the influence of evaporation processes on the line intensity in function of the discharge gas and the chemical binding of the substance analyzed. From the physical properties of the discharge gas, a strong influence was found in the spectral-analytical results that had been caused by basic variations of the evaporation rate of electrodes, flow procedures during the burnup, heat removal, arc form, and temperature distribution in the arc plasma. (auth)

12561 (KFKI-72-73) SINGLET TRANSITION ENERGIES, MIM WAVE FUNCTIONS, PPP CHARGE DENSITIES AND BOND ORDERS OF THE MONO- AND DISUBSTITUTED HALOGENBENZENES. Kiss, A. I.; Martin, A.; Szoke, J. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Feb 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

12562 (LA-5199-MS) EXPERIMENTS IN THE NEW LASL MPD ARCJET TEST FACILITY. Fradkin, D. B.; Roehling, D. J. (Los Alamos Scientific Lab., N. Mex.). Feb 1973. Contract W-7405-eng-36. 9p. Dep. NTIS $3.00.

The new magnetoplasmadynamic (MPD) arcjet test facility at LASL is described. Preliminary performance measurements on a steady state lithium-fueled applied-field MPD arcjet are evaluated on the basis of thrust measured directly with a unique, highly sensitive, parallel pendulum thrust stand. Arc input electrical powers were between 10 and 20 kW, currents between 300 and 550 A, input mass flow rates varied from 23 to 41 mg/s, and applied field strengths were between 0.09 and 0.27 T. Thrust was found to correlate with the product of arc current and applied magnetic-field strength. Thrust densities at the anode exit plane were as high as 500 N/m^2. Effective exhaust velocities of 2×10^4 m/s (I_{sp} = 2050 s) were observed. Thrust efficiency increased linearly with exhaust velocity reaching 35% at the highest measured value. Mass entrainment effects on the measurements are considered and discussed. (auth)

12563 (LA-5231-MS) ECOMIUM ON SOLAR SAILING. Cotter, T. P. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

The principles and merits of solar sailing are examined. The construction, operation, and flight of an unmanned instrumental solar sailing vehicle on a round trip of exploration to the neighborhood of Mars under command guidance from earth are described. (TFD)

12564 (LA-5243-MS) FRESNEL DIFFRACTION EFFECTS IN THE DESIGN OF HIGH-POWER LASER SYSTEMS. Campillo, A. J.; Pearson, J. E.; Shapiro, S. L.; Terrell, N. J. Jr. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. Contract W-7405-eng-36. 4p. Dep. NTIS $3.00.

Fresnel diffraction by circular apertures for beams commonly encountered in high-power laser systems is investigated. Striking agreement is demonstrated between experimental results and theoretical calculations for beams with uniform and Gaussian intensity profiles. Methods are discussed for minimizing the occurrence of severe intensity variations and resulting self-focusing problems in high-power laser amplifiers. (auth)

12565 (LA-UR-73-695) ORGANIC SYNTHESIS WITH STABLE ISOTOPES. Whaley, T. W.; Kerr, V. N.; Ott, D. G. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 16p. (CONF-730525-1). Dep. NTIS $3.00.

From conference on stable isotopes in chemistry, biology and medicine; Argonne, Illinois, USA (9 May 1973).

12566 (LA-UR-73-795) RADIATION-INDUCED DAMAGE TO NaCl BY 10.6-μ FRACTIONAL JOULE, NANOSECOND PULSES. Reichelt, W. H.; Stark, E. E. Jr. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 10p. (CONF-730528-2). Dep. NTIS $3.00.

Fractional-joule nanosecond pulses from the Los Alamos pulsed CO_2 laser system were used to obtain preliminary breakdown data for optical-quality NaCl. Both surface and bulk damage have been observed. Surface damage in some samples takes the form of a rectangular craze pattern. This pattern is at the surface and similar to that observed by Bastow et al. (Nature, 222: 27(1969)) in TiC irradiated with light pulses from a Q-switched ruby laser. Estimated thresholds for breakdown and damage patterns are given. (auth)

12567 (LBL-1798) SUCCESSIVE POLARIZATION MEASUREMENTS ON AN IMPROPER MIXTURE. Richardson, M. L.; Clauser, J. F. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-eng-48. 10p. Dep. NTIS $4.00.

Two successive linear polarization measurements were performed on the improper mixture of photons resulting from the $7^1S_0 \rightarrow 6^3P_1$ transition of ^{202}Hg. Improper mixtures are important in measurement theory, and it is speculated that a basic difference in the time evolution of proper and improper mixtures might resolve some of the difficulties in this field. The experimental data are in agreement with the quantum mechanical prediction that no such difference exists. (auth)

12568 (NP-19783) GENERALIZATIONS OF THE BILATERAL LAPLACE TRANSFORM. Lemei, H. (Technische Hogeschool, Delft (Netherlands)). [nd]. 65p. Dep. NTIS (U. S. Sales Only) $5.25.

Thesis.

12569 (NRC-TT-1630) CERTAIN PROPERTIES OF THE STRUCTURE OF THE DNA OF PASTEURELLA PESTIS STRAIN EB. Vanyushin, B. F.; Dedieva, E. P.; Mazin, A. L.; Mitina, V. S.; Ivanovskii, N. N. Translated by V. Poppe (National Research Council of Canada, Ottawa) from Nauch. Dokl. Vyssh. Shk., Biol. Nauki; 12: 82-86(1970). 9p. Dep. NTIS (U. S. Sales Only) $3.00.

The high-polymer DNA was isolated from the cells of Pasteurella pestis EB. The composition of the DNA and its content of pyrimidine sequences of various lengths (isopliths) were studied. The content of guanine + cytosine base-pairs in this DNA determined spectrophotometrically was 48.6 mol % and 45.6 mol % at the melting point (88°C). The only minor methylated base found in the DNA of P. pestis was N^6-methyladenine (0.27 mol %). 5-methylcytosine could not be detected. In contrast to animal DNA's, the DNA of P. pestis (β = 2.89) was characterized by a lesser frequency of occurrence of the pyrimidine blocks. (HLW)

12570 (NRC-TT-1634) COMPARATIVE EVALUATION OF METHODS FOR DETERMINING THE PRODUCTION OF CHIRONOMID LARVAE. Sokolova, N. Yu. Translated by G. Smirnovv (National Research Council of Canada, Ottawa), from Zool. Zh.; 50: No. 3, 422-433(1971). 26p. Dep. NTIS (U. S. Sales Only) $3.50.

12571 (ORNL-TM-4220) CORRELATION OF AVAILABLE LITHIUM CHLORIDE AND HYDROCHLORIC ACID ACTIVITY COEFFICIENT DATA. McDowell, W. J. (Oak Ridge National Lab.,

Tenn.). Jun 1973. Contract W-7405-eng-26. 21p. Dep. NTIS $3.25.

12572 (ORNL-UR-109) SELECTED FACTORS INFLUENCING CITY GROWTH, 1960-1970. Sturgis, R. B. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 31p. Dep. NTIS $3.75.

Growth factors examined are assumed to be city-associated characteristics that give some cities a competitive advantage in attracting people, thereby resulting in a population growth. (MOW)

12573 (ORO-1597-5) STUDIES ON NUTRITION OF THE PRE-PLACENTAL EMBRYOS OF THE MAMMAL. Seventh Year Progress Report. Daniel, J. C. Jr. (Tennessee Univ., Knoxville. Dept. of Zoology). [nd]. 7p. Dep. NTIS $3.00.

12574 (ORO-4254-7) POTENTIOMETRIC DETERMINATION OF PHOSPHATE. Madden, M. L. (Oklahoma State Univ., Stillwater). May 1972. 74p. Dep. NTIS $5.75.

Thesis.

A bismuth metal billet electrode was constructed and tested as an end-point indicator for the volumetric potentiometric titration of phosphate with standard bismuth nitrate solution in acid medium. Details of these results and of the design of the electrode are reported. An electrode which uses a bismuth amalgam for the sensing element showed Nernstian response to phosphate in nitric acid medium over a concentration range of nearly five decades. (DLC)

12575 (ORO-4254-8) THEORY AND APPLICATION OF CONTINUOUS MOINTORING FOR CHEMICAL RESEARCH IN NATURAL WATER SYSTEMS. Rice, G. K.; Varga, L. P. (Oklahoma State Univ., Stillwater). 26 Oct 1972. 25p. Dep. NTIS $3.25.

When continuous monitoring is used to collect data reflecting short time interval changes, measurements are required of multiple parameters at time intervals of a few hours or less, continuously for months or years. Generation of this type of data dictates automation. Continuous monitoring in natural water systems requires that methods for measuring the necessary parameters be instrumented and then automated in a manner that produces continuous (or nearly continuous) data accurately for extended periods of time. This premise is the basis of this development. (56 references) (auth)

12576 (ORO-4254-10) SOURCES, SINKS, AND METHODS OF ANALYSIS OF ORGANIC NITROGEN COMPOUNDS IN FRESH WATER SYSTEMS. Kelly, J. A. (Oklahoma State Univ., Stillwater). 1971. 31p. Dep. NTIS $3.75.

Problems associated with "basic" trace organics in natural systems are reviewed in order to delineate the significance of their sources, sinks, and methods of analysis. (46 references) (LMT)

12577 (ORO-4254-13) PHYTOPLANKTON COMMUNITY STRUCTURE AND NUTRIENT RELATIONSHIPS IN LAKE CARL BLACKWELL, OKLAHOMA. Faust, A. R. (Oklahoma State Univ., Stillwater). Jul 1973. 60p. Dep. NTIS $5.00.

Thesis.

12578 (ORO-4254-14) BIOGEOCHEMISTRY OF A RESERVOIR ECOSYSTEM. Report No. 4, September 1, 1972-June 1, 1973. Varga, L. P.; Toetz, D. W.; Dorris, T. C. (Oklahoma State Univ., Stillwater). 1973. Contract AT(40-1)-4254. 41p. Dep. NTIS $4.25.

12579 (SC-RR-720386) SOLID ELECTROLYTE THERMAL BATTERY. Nissen, D. A.; Carlsten, R. W. (Sandia Labs., Albuquerque, N. Mex.). Jun 1973. 37p. Dep. NTIS $4.00.

A study was conducted to determine the feasibility of a thermally activated battery based on the electrochemical system $Ag/AgI/I_2$. (auth)

12580 (SLA-73-51) STUDIES ON DERMESTID BEETLE: MATERIALS INTERACTIONS. I. Materials Preferences. Brannen, J. P.; Gennaro, A. L.; Salb, T. J.; Aday, B. J.; Woolfolk, C. D. (Sandia Labs., Albuquerque, N. Mex.). Apr 1973. 52p. Dep. NTIS $4.75.

When exposed to a variety of packaging and electrical insulating materials, the dermestid beetles Anthrenus flavipes and Dermestes maculatus tend to associate with those items which are of low density, bulky, and chewable. This observation is independent of the presence or absence of food. There is no evidence that any of the electrical insulating materials are an attractant for the beetles. All materials exposed to the beetles were damaged to some extent. (23 figures, 15 references) (auth)

12581 (SLA-73-404) COMPLETE RELIABILITY PROGRAM AS APPLIED AT SANDIA LABORATORIES. Muench, J. O. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 11p. Dep. NTIS $3.00.

The engineering aspects of a complete reliability program as it is applied at Sandia Laboratories are discussed. The four major activity areas of a complete reliability program are discussed in detail and each area is shown to be closely interrelated to the others. (auth)

12582 (SLA-73-464) ANALYSIS, TESTING, AND DESIGN OF FILAMENT-WOUND, CARBON-CARBON BURST TUBES. Reuter, R. C. Jr.; Guess, T. R. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 29p. Dep. NTIS $3.00.

Filament wound, carbon-carbon, composite tubular specimens were tested to failure by internal pressurization of a compliant, rubber bladder. When the specimen length exceeded the bladder length, significant strength increases were measured relative to those measured when the specimen length was equal to or less than the bladder length. A stress analysis is performed to study the effects of this material overhang on strength measurement variations using Laplace transform techniques. An explanation for and discussion of the strength variation is included. Optimum specimen design criteria are presented which minimize data falsification and material consumption. (auth)

12583 (SLA-73-5271) AIRVAL; DOD PROGRAM TO EVALUATE AIR-TO-AIR MISSILE EFFECTIVENESS. Latta, T. E. (Sandia Labs., Albuquerque, N. Mex.). Mar 1973. 30p. (CONF-730428-1). Dep. NTIS $3.50.

From 11th symposium on infrared countermeasures; White Oak, Maryland, USA (10 Apr 1973).

The AIRVAL program has conducted a survey to determine the extent of past infrared (IR) signature measurements on high-performance jet aircraft. The results of this survey have been used to categorize broadly aircraft signatures and to indicate areas requiring further signature measurement. Measurements on the F-102 are now underway at Naval Weapons Center. The results of these measurements will be compared to signature predictions of the F-102 as calculated by Grumman Aircraft Corp. Additional IR signature measurements will be made this calendar year on the A-3, A-4, A-7, F-4, F-5, and F-14 by the measurement groups at the Naval Missile Center and Eglin AFB using advanced instrumentation and techniques. The results of these measurements will be combined with target vulnerability models and missile guidance, fuze, and warhead characteristics in a computer model to determine the predicted outcome of missile/target encounters. The results of a drone firing program will be compared to the computer model predictions. (auth)

12584 (SLA-73-5282) ELECTRONIC RECOMBINATION AND THE EFFECTS OF METASTABLES IN A HELIUM AFTERGLOW. Johnson, A. W.; Gerardo, J. B. (Sandia Labs., Albuquerque, N. Mex.). [nd]. 4p. (CONF-730906-2). Dep. NTIS $3.00.

From 11th international conference on phenomena in ionized gases; Prague, Czechoslovakia (10 Sep 1973).

12585 (SLA-73-5483) HOLOGRAPHIC MEASUREMENTS OF THE PLASMAS IN A HIGH-CURRENT FIELD EMISSION DIODE. Mix, L. P.; Kelly, J. G.; Kuswa, G. W.; Swain, D. W.; Olsen, J. N. (Sandia Labs., Albuquerque, N. Mex.). 1973. 14p. (CONF-730529-3). Dep. NTIS $3.00.

From 12th symposium on electron, ion, and laser beam technology; Cambridge, Massachusetts, USA (21 May 1973).

Two exposure holographic interferometry was used to obtain the first quantitative measurements of the plasma densities in an intense electron beam diode. Several diode configurations which produce an intense pinch of the electron beam at the anode plane have been investigated. Holograms indicating the temporal and spatial evolution of the plasmas in these diodes are presented. Two types of plasmas are observed in these diodes: a lower density plasma ($< 10^{18}/cm^3$) with a velocity of 5 to 10 cm/μsec and a higher density plasma ($> 10^{18}/cm^3$) with a velocity of about 2 cm/μsec. Preliminary analysis indicates that the lower-density plasma plays a dominant role in determining the primary beam dynamics. (auth)

12586 (SRO-676-1) CHEMISTRY OF RUTHENIUM COMPLEXES. Final Report. Mercer, E. E. (South Carolina Univ., Columbia. Dept. of Chemistry). 1972. Contract AT(38-1)-676. 12p. Dep. NTIS $3.00.

Studies of blue ruthenium chloride complexes show that the species responsible for the blue color are dinuclear, mixed oxidation state complexes containing ruthenium (II, III). Ir and Raman studies of nitrosylruthenium complexes are also reported. (DHM)

12587 (TID-26344) DYNAMICS OF LITTER DECOMPOSITION, MICROBIOTA POPULATIONS, AND NUTRIENT MOVEMENT FOLLOWING NITROGEN AND PHOSPHORUS ADDITIONS TO A DECIDUOUS FOREST STAND. Kelly, J. M. (Tennessee Univ., Knoxville). Jun 1973. 211p. Dep. NTIS $12.75.

Thesis.

12588 (TID-26346) IMMUNOSUPPRESSION AND CARCINOGENESIS IN THE SYRIAN HAMSTER DURING TOPICAL APPLICATION OF 7,12-DIMETHYLBENZ[A]ANTHRACENE (DMBA). Szakal, A. K. (Tennessee Univ., Knoxville). Aug 1972. 81p. Dep. NTIS $6.25.
Thesis.

12589 (TID-26347) PROGRESS REPORT (1972–1973) ON AEC SUPPORTED RESEARCH ON ECOLOGICAL STUDIES ON THE DYNAMICS OF PLANKTONIC ALGAE WITH SPECIAL REFERENCE TO THEIR MICROSTRATIFICATION. (Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology). [nd]. Contract AT(11-1)-1820. 6p. Dep. NTIS $3.00.

12590 (UCID-16181) SUGGESTIONS FOR IMPROVING CO_2 MODE-LOCKED OSCILLATORS. Davis, D. T. (California Univ., Livermore. Lawrence Livermore Lab.). 3 Jan 1973. Contract W-7405-eng-48. 25p. Dep. NTIS $3.25.
This report outlines some suggestions for improving the CO_2 mode-locked oscillator with single-pulse selector. The goals of these suggestions are to obtain a laser output with a higher brightness, shorter pulses and pulse shaping, wavelength and mode control, reliability, and compatibility with a large system. Several of these ideas are new and are presented for the first time in this report. (auth)

12591 (UCRL-6128(Del.)) BASSOON: ELF COMMUNICATION SYSTEM. Christofilos, N. C. (California Univ., Livermore. Lawrence Livermore Lab.). 29 Aug 1960. Contract W-7405-eng-48. 49p. Dep. NTIS $4.50.
An antenna arrangement is proposed to radiate a few kilowatts of power at the frequency range 25 to 35 cps. The required radiated power was calculated in consideration of recent experimental results obtained by the Lincoln Laboratory indicating a Q of 4 of the earth–ionosphere cavity at the lowest mode, namely, 8 cps. The proposed antenna is just a group of conventional-type, 4- to 6-kV, power transmission lines. These lines are spaced a few miles apart covering an area of several thousand square miles. Both ends of these lines are plugged into the ground thus generating a tangential electric field on the earth's surface over large areas which are acting as a slot antenna. These antennas can also be considered as equivalent to a gigantic loop of effective height equal to the skin depth. In selected areas the skin depth is of the order of several miles. (auth)

12592 (UCRL-73456(Rev.2)) CANCER RADIOCHEMOTHERAPY WITH 7-TRITIOTETRACYCLINE. I. Rationale and Preliminary Animal Results. Wood, P.; Haury, J.; Davis, R.; Wood, L. (California Univ., Livermore. Lawrence Livermore Lab.). 30 Aug 1971. 26p. (CONF-710809-20). Dep. NTIS $3.50.
From tritium symposium; Las Vegas, Nevada, USA (30 Aug 1971).
A rationale is presented for work using tetracycline, heavily labelled with tritium in the 7-carbon position, in malignancy treatment. Also presented are preliminary results of such a study in normal and malignant tumor-bearing rats. While this has been a small animal-number investigation, and results are not yet conclusive, it presently appears that this radiochemotherapeutic approach has yielded basically positive results in a conservative model system. Eventually, it may have therapeutic utility in high-risk cases of human malignancy. (auth)

12593 (UCRL-74286) RELATIONSHIP OF SURFACE FINISH TO DIMENSIONAL TOLERANCE. Bryan, J.; Lindberg, E. (California Univ., Livermore. Lawrence Livermore Lab.). 3 Nov 1972. 16p. (CONF-730512-1). Dep. NTIS $3.00.
From international conference on surface technology; Pittsburgh, Pennsylvania, USA (1 May 1973).
There is no basis for the traditional concept of a "direct relationship" between smooth surfaces and close tolerances because there are so many exceptions. Finishes and tolerances should be regarded as separate parameters since they have separate engineering functions to perform. Although smooth surfaces are easier to measure, a number of techniques are available to administer close tolerances in the presence of roughness if the technique is properly specified. (auth)

12594 (UCRL-74397) GENERATION OF SINGLE 1-ns PULSES AT 10.6 μ WITHOUT MODE LOCKING. Smith, D. L.; Davis, D. T. (California Univ., Livermore. Lawrence Livermore Lab.). 26 Jan 1973. 9p. (CONF-730515-2). Dep. NTIS $3.00.
From fourth biennial conference on laser engineering and applications; Washington, District of Columbia, USA (30 May 1973).
Pulses of 1 ns duration have been generated at 10.6 μ without mode locking the CO_2 TEA oscillator. A scheme is described which allows generation of a single pulse or a pair of pulses with adjustable spacing between pulses. (auth)

12595 (UCRL-74504(Rev.1)) RADIATIVE TRANSFER CONSIDERATIONS FOR KINETIC MODELING AND SENSITIVITY STUDIES. Gelinas, R. J. (California Univ., Livermore. Lawrence Livermore Lab.). 28 Mar 1973. 8p. (CONF-730614-1). Dep. NTIS $3.00.
From conference on environmental impact of aerospace operations in the high atmosphere; Denver, Colorado, USA (11 Jun 1973).

12596 (UCRL-74566) DIFFERENTIAL THERMAL ANALYSIS APPARATUS FOR USE AT CRYOGENIC TEMPERATURES. Catalano, E.; Rinde, J. A.; English, J. C. (California Univ., Livermore. Lawrence Livermore Lab.). 13 Feb 1973. 17p. (CONF-730895-1). Dep. NTIS $3.00.

12597 (UCRL-74607) ACOUSTIC EMISSION FROM FORMATION AND ADVANCEMENT OF CRACKS. Tatro, C. A.; Liptai, R. G.; Moon, D. W. (California Univ., Livermore. Lawrence Livermore Lab.). 5 May 1973. 45p. (CONF-730605-1). Dep. NTIS $4.25.
The detection and use of acoustic emission in materials research is discussed, with special emphasis on its unique advantages as a research tool. The disadvantages and limitations of acoustic emission technology in research are also discussed. Acoustic emission technology has not been used widely in hydrogen embrittlement and stress corrosion studies. A summary of the available literature is included here, along with summaries of work pertinent to a better understanding of the usefulness of acoustic emission for these studies. Examples of acoustic emission data from stress corrosion studies in high strength steels, not yet reported elsewhere, are included and are compared with results from the literature. Those deformation and failure mechanisms known or suspected of operating during hydrogen embrittlement or stress corrosion cracking of iron-based alloys are discussed as acoustic emission sources. Those phenomena that do not serve as acoustic emission sources are identified. The various important sources are classified in terms of the amplitude and frequency content of the emitted stress wave, though this classification cannot be done on a quantitative basis. (6 figures, 31 references) (MOW)

12598 (UCRL-Trans-10691) PART PLAYED BY CHAIN REACTIONS IN THE FUNCTIONING OF KASPER–PIMENTEL PERFLUOROALKYL IODIDE LASERS. Skorogobatov, G. A.; Khomenko, V. E. Translated from Vestn. Leningrad. Univ., Fiz., Khim.; No. 10, 170-174(1970). 10p. Dep. NTIS $3.00.

12599 (UCSC-34-P-185-X-3) ORGANELLES AND THE REGULATION OF PLANT METABOLISM. Technical Progress Report, August 1, 1972–Present. Beevers, H. (California Univ., Santa Cruz). [nd]. Contract AT(04-3)-34. 5p. Dep. NTIS $3.00.

12600 (UCSD-34-P-133-X-7) GENETIC CONTROL OF ENZYME FORMATION. Progress Report. (California Univ., San Diego). [nd]. Contract AT(04-5)-34 O.A. 133. 6p. Dep. NTIS $3.00.
Data obtained during a year of study of tryptophan metabolism in various organisms are summarized. (LMT)

12601 (UCSD-34-P-159-X-4) SYNTHESIS AND SECRETION OF HYDROXYPROLINE-RICH GLYCOPROTEINS OF HIGHER PLANTS. Progress Report, August 1, 1972–July 31, 1973. Chrispeels, M. J. (California Univ., San Diego). [nd]. Contract AT(04-3)-34, PA 159. 10p. Dep. NTIS $3.00.

12602 (UR-3490-208) DEVELOPMENT OF THE VASCULAR SYSTEM IN THE HAMSTER MALIGNANT NEURILEMMOMA. Eddy, H. A.; Casarett, G. W. (Rochester Univ., N. Y. (USA). Clinical Radiation Research Center). 1972. 40p. Dep. NTIS $4.00.
Direct observations of the development of the vasculature in the Syrian hamster malignant neurilemmoma were made during growth of the tumor in the transparent cheek pouch chamber. These studies also served as control data for investigation of the effects of ionizing radiation on this vascular system. (auth)

12603 (UR-3490-326) LATTICE ENERGIES OF ALKALINE EARTH HALIDE CRYSTALS WITH POLARIZABLE ATOMS AND THE CRYSTAL STRUCTURE OF HYDRATED SODIUM COPPER PYROPHOSPHATE $Na_6Cu(P_2O_7)_2 \cdot 16\ H_2O$. Yuen, P.-S. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1973. 129p. Dep. NTIS $8.50.
Thesis.

12604 (UR-3490-327) STUDIES OF ERYTHROCYTE MEMBRANE RIGIDITY. Heusinkveld, R. S. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1973. 116p. Dep. NTIS $8.00. Thesis.

By means of ATP-depleted erythrocytes and an improved elastomer technique, it was found that the intrinsic rigidities of intact erythrocytes and of erythrocyte ghosts were not increased by depletion of ATP. (LMT)

12605 (Y-DA-5091) COPOLYMERIZATION OF BENZOFULVENE COMPOUNDS. Horne, O. J. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). [nd]. Contract W-7405-eng-26. 8p. (CONF-730507-4). Dep. NTIS $3.00.

From American Chemical Society; Detroit, Michigan, USA (1 May 1973).

The relationship existing between carbon properties and the chemistry of the polymeric precursor system is strongly indicated. Further, it seems that control of carbon properties necessitates control of the precursor and that carbon with a specific set of properties can be prepared by the appropriate choice of a precursor. (auth)

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